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Water Plant Optimization Study

KINGSTON WATER TREATMENT PLANT

December 1990

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Water Plant Optimization Study

Kingston Water Treatment Plant

Project No. 7-2033

December 1990

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as represented by the Minister of the Environment

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WATER PLANT OPTIMIZATION STUDY
KINGSTON WATER TREATMENT PLANT

SUMMARY OF FINDINGS AND RECOMMENDATIONS

The purpose of the Water Plant Optimization Study (WPOS) is to document and review the present conditions and determine an optimum treatment strategy for contaminant removal at the plant, with emphasis on the removal of particulate materials and the disinfection processes.

In striving for excellence in water treatment, it is important to examine all possible approaches, but first, optimum use should be made of the processes already in place.

This optimization study is a beginning and not an end to itself; it is the start of an ongoing documentation of the operation of the plant. It is recommended that this document be updated on an annual basis.

Considerable strides towards optimization of the Kingston Water Treatment Plant have been made by the Kingston Public Utilities Commission operational staff, as demonstrated by the consistently low plant effluent turbidity values (usually <0.2 FTU). This study has identified some areas of further action and study.

In an effort to optimize particulate removal and disinfection at the Kingston Plant, the following recommendations are suggested:

PHYSICAL IMPROVEMENTS

- Install filter effluent turbidimeters on the six filters.

STUDIES

- Conduct laboratory testing to determine relative merits of flash mixing.
- Conduct plant scale studies on the effects of flow rate on the flocculation tank performance.
- Conduct plant scale testing to evaluate the effect of lower constant filtration rates on filter effluent quality.
- Investigate the backwash procedure to evaluate the optimum rise rates and wash water volumes.
- Evaluate the accuracy of the high lift flow metering.

STUDIES (cont'd)

- Conduct a research study to determine how the Kingston plant is able to maintain very low effluent turbidities.

OTHER RECOMMENDATIONS

- Record a turbidity profile, consisting of raw, settled, and filtered turbidities, on all filters at least once every 4 hours.

- The Ministry of the Environment should develop a surrogate measurement for chlorinated by-products for use in water plants in Ontario.

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TERMS OF REFERENCE

WATER PLANT OPTIMIZATION STUDY
KINGSTON WATER TREATMENT PLANT

INTRODUCTION AND TERMS OF REFERENCE

The Ontario Ministry of the Environment has instituted a Drinking Water Surveillance Program, consisting of a continuously updated data base of water quality information on Ontario water treatment plants. In connection with the surveillance program, a specific plant investigation and process evaluation study is desired for each plant entering the program. The study is to document and review the present operating conditions, and determine an optimum treatment strategy for particulate removal and disinfection at the plant. The terms of reference for this Water Plant Optimization Study has been prepared by the Ministry, and is included at the back of the report, following the appendices. This optimization study has been conducted in accordance with the terms of reference.

The Kingston Public Utilities Commission provides the water supply and distribution system for the City of Kingston and Pittsburg Township. This optimization study provides a detailed examination of three years of daily and monthly plant operating data, a description of the facilities in place at the plant and their operation, and recommendations which could improve the particulate removal and disinfection performance of the plant.

The Kingston plant is able to maintain very low plant effluent turbidities, usually less than 0.2 FTU. The low raw water turbidity and conscientious plant operations contribute to this excellent plant performance.

SECTION A

RAW WATER SOURCE

SECTION A
RAW WATER SOURCE

A.1 General Quality

The Kingston Water Filtration Plant draws water from Lake Ontario. The raw water quality is generally good.

In the years 1984 - 1986, the general raw water quality parameters varied as follows:

Colour (TCU)	1.5-9.0		(2)
Turbidity (FTU)	0.6-10.0	(Avg. = 1.1)	(1)
Temperature (°C)	0.3-20.5		(1)
pH	7.91-8.35		(2)
Hardness (mg/L as $CaCO_3$)	123-146*	(Avg. = 130)	(2)
Alkalinity (mg/L as $CaCO_3$)	91-111.2*	(Avg. = 100)	(2)
Aluminum (mg/L)	0.01-0.03		(3)
Iron (mg/L)	0.001-0.16	(Avg. = 0.03)	(2)
Manganese (mg/L)	0.001-0.048		(2)
Fecal Coliform (per 100 ml)	0-500		(4)
Standard Plate Count	3-2400+		(2)

(1) Minimum and maximum daily values recorded on monthly summary sheets kept at the Kingston WTP for the period of January 1984 to December 1986.

(2) Values taken from DWSP chemical analysis for the period of January 1985 to December 1986.

(3) Minimum and maximum daily values recorded in the daily log book kept at the Kingston WTP for the period of January 1984 to December 1986.

(4) Values taken from MOE and MOH daily results sheets kept at the Kingston WTP for the period of January 1984 to December 1986.

* Uncommonly high values have been omitted and are assumed to be in error.

A.2 Security

The Kingston Water Treatment Plant security measures consist of keeping the doors locked and equiped with alarms. The windows, however, do not have alarms. There are no intake or source protection measures in place, and should a spill or other security event happen, the operators would shut down the low lift pumps and call the plant superintendent for further instructions.

SECTION B
FLOW MEASUREMENT

SECTION B
FLOW MEASUREMENT

B.1 Raw

Raw water flow is measured by one of two flow meters. The flow through the north header is measured by a 760 mm diameter venturi tube which has a maximum capacity of 81.7 ML/d. The flow through the south header is measured by a 914 mm diameter Dall insert tube, which has a maximum capacity of 136 ML/d.

The differential pressure transducers and transmitters are located in the low lift pumping station basement. The flow signals are time duration and are recorded in the main control room. The two time pulse signals are converted to 4 to 20 mA signals which are summed, and the summed signal is converted to a time pulse signal for recording total flow and raw water chemical feed control.

B.2 Treated

Treated water flow is measured by two 600 mm diameter venturi tubes. The capacities of the two meters are 86 ML/d each.

The differential pressure transducers and transmitters are located in the high lift pumping station basement. The transmitters produce 4 to 20 mA and time pulse signals. The time pulse signals are sent to the recorders in the main control room. The 4 to 20 mA signals are sent to the main control panel where they are summed and converted to a time pulse signal which is used for recording total flow and post chlorine/sulphur dioxide feed control.

B.3 Backwash

There is one backwash water pump and the backwash water flow is measured by a 600 mm diameter insert venturi nozzle which has a maximum capacity of 81.7 ML/d. The differential pressure transducer and transmitter are located in the filter pipe gallery. The flow signal is 1 to 5 V DC which is recorded in the Main Control Room. The 1 to 5 V DC signal is converted to a time pulse signal which is used for integration of wash water flow.

B.4 Filters

Filters 1-4 each have a Simplex controller with a venturi liner. The maximum capacity of each liner is 16 ML/d. Filters 5 and 6 have 450 mm diameter venturi insert flow meters which have a maximum capacity of 34 ML/d each.

The maximum filter rates are set individually at each filter, but can be cut back by a clearwell level override.

B.5 Validity

The plant maintenance staff calibrate the transmitters approximately every six months by inducing a test differential pressure on the transmitters. The transmitter signals and recorders are calibrated against the test differential pressures. Observations during the site visits would indicate that this work is carried out very well.

There are no absolute minimum effective capacities for each venturi meter, however, unreliable flow measurements are usually experienced when the flowrate is less than 20% of the meter's rated capacity. All of the above mentioned venturi meters normally operate at flows greater than 20% of their rated capacities. Occasionally, the treated water flow may fall below this lower boundary.

The 1953 west treated water venturi tube was removed and cleaned in 1984. The venturi had some incrustation, but was in good condition.

The plant staff are diligent in their understanding of water flows. Tests have been conducted to assess unmetered plant flow losses and these are: leaking filter drains gates, 700 m^3/d (1.4%); surface wash agitators, 70 m^3/d; plant service water, 360 m^3/d; and a variable miscellaneous quantity which ranges up to 230 m^3/d. The staff continues to investigate and correct any unmetered plant flow losses.

The per capita flow data provided in Table 1.1 of Appendix A indicate a slightly higher than normal average daily flow rate. This is attributable to leakage in the distribution system.

SECTION C

PROCESS COMPONENTS

SECTION C
PROCESS COMPONENTS

C.1 General

This section includes detailed information on Design Data and Chemical Systems.

This section also contains a series of photographs to illustrate the major plant component and chemical feed systems.

C.2 Design Data

(a) Plant Capacity

The original plant was built in 1953. It included flocculation, settling, filters, and appropriate pumping. In 1968, the plant underwent an expansion consisting of similar flocculation, settling, filters and appropriate pumping.

The plant facilities are currently rated at 118 ML/d, with a present average daily flow of about 50 ML/d. All of the operating data presented herein are based on flows of 50 and 118 ML/d.

(b) Intake

The plant has two intake pipelines, as follows:

Old Intake • 1949, 366 m long, 750 mm diameter steel pipe joined by dresser couplings, estimated capacity 90.9 ML/d.

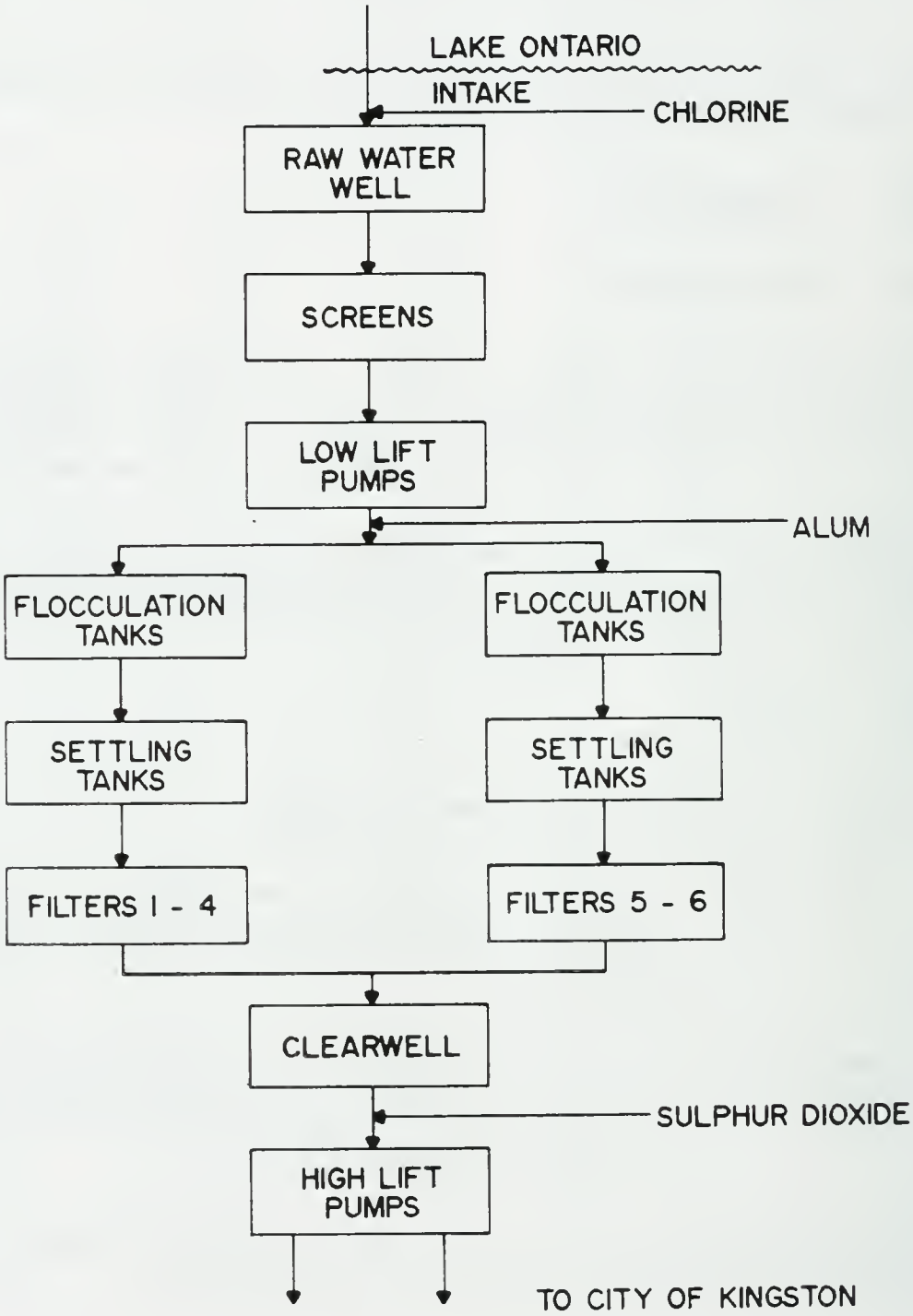
New Intake • 1970, 824 m long, 1200 mm diameter, 153 m of reinforced concrete and 671 m of steel pipe, estimated capacity 250 ML/d.

The old intake is not normally used. It is affected by turbid water conditions in the lake to a greater extent than the 1970 intake.

FIGURE I

KINGSTON WATER TREATMENT PLANT

PROCESS AND PIPING SCHEMATIC



(b) Intake (cont'd)

The old intake has a timber crib situated 15 m below the average water level. The new intake is a bellmouth intake, located 17 m below the average water level.

Chlorine is added at the end of the intake pipe, as the water enters the raw water well.

(c) Surge Well

The new intake pipe passes through a concrete surge well and terminates in the raw water well. The surge well is cylindrical in shape, 1.4 m in diameter and 4.6 m deep.

(d) Raw Water Well

The intake pipe terminates in the concrete raw water well just before the travelling screens. The well has an effective volume of about 165 m^3.

(e) Screening

There are two Link-Belt travelling water screens in concrete screen chambers. The screen well is 1.9 m wide x 7.3 m deep. The low water depth of the screen is 2 m, and the high water depth is 5.8 m. The mesh material is 2 mm diameter brass wire with 13 mm openings.

The capacities of the screens are approximately 115 ML/d each. Only one screen is operated at a time.

(f) Low Lift Pumping

There is one concrete low lift suction well, with dimension of 5.7 m x 4.3 m x 2.7 m. The four low lift pumps and their capacities are listed below:

(f) Low Lift Pumping (cont'd)

PUMP NO.	TYPE	CAPACITY (ML/d)	POWER (kW)
1	Electric/Diesel	50	55
2	Electric	41	45
3	Electric	50	55
4	Electric/Diesel	77	112
	TOTAL INSTALLED	218	
	FIRM CAPACITY	141	

All low lift pumps are single stage, vertical centrifugal pumps. The firm capacity assumes the loss of the largest pump.

(g) Flash Mixing

There is no flash mixing at the Kingston plant.

(h) Flocculation

All flocculation tanks are hydraulic spiral upflow and are made of concrete.

There are nine flocculation tanks, each 4.9 m x 4.9 m x 6.6 m deep with three sets of 3 cells (2 - stage flocculation). The total volume of the flocculation tanks is 1426 m^3. The flocculation detention times at 118 and 50 ML/d are 17 and 41 minutes, respectively.

Raw water enters the bottom of the middle cell of the mixing chambers and flows in a spiral direction to the top. The water flow splits into four vertical shafts, two of which exit into the bottom of either adjacent cell. Again, the water flows in a spiral direction to the top, then enters the associated settling tank.

The mixing velocity gradients in the flocculation tanks have been estimated based on a mixing energy input equivalent to the loss of momentum of the water entering the tanks. This is a conservative estimate of the total mixing, since other energy losses occur during passage of the water from one tank to another.

(h) Flocculation (cont'd)

This additional mixing energy could result in G values which are as much as 25 percent higher. The actual energy loss can be obtained from precise hydraulic tests.

Useful flocculation velocity gradients range from 100 to <10 sec^{-1}. A "tapered" or stepped series should be used; the highest mixing is provided initially, progressing through a series of cells of decreasing mixing levels. Additionally, the dimensionless parameter, Gt, which is the product of velocity gradient and the duration of mixing, is a most useful parameter which usually must have values within the range of 10^4 to 10^5.

Estimated Velocity Gradient at 10°C:

	50 ML/d	118 ML/d
Cell 1	$G = 14\ s^{-1}$	$G = 52\ s^{-1}$
Cells 2 or 3	$G = 4\ s^{-1}$	$G = 13\ s^{-1}$
Overall	$Gt = 1.8 \times 10^4$	$Gt = 2.7 \times 10^4$

(i) Settling Tanks

The settling tanks are horizontal cross-flow and are made of concrete.

There are three settling tanks, each is 14.9 m x 25 m x 5.3 m deep. The total volume and surface area of the settling tanks are 5923 m^3 and 1118 m^2, respectively. The settling detention times at 118 and 50 ML/d are 72 and 171 minutes, respectively. For similar flow conditions, the overflow rates are 4.4 and 1.9 m/h, respectively.

(j) Filters

The Kingston Water Filtration Plant has a total of 6 filters, each 6.4 m x 12.8 m, which provides a total filtration area of 491 m^2. All filter boxes are constructed of concrete. All filters have surface agitators and are dual media.

The Kingston plant operators conduct a filter media study once a year on each filter. The depth of media (to the gravel) is measured and recorded at 32 grid locations in each filter.

FILTERS 1-4 (1954)

	W (m)	L (m)	(1) D (m)	SURFACE AREA (m^2)
Individual	6.4	12.8	2.7	81.9
TOTAL				327.6

NOTES:

(1) D (m) is depth of water in the filter box in metres.

(2) Filters 1-4 have cast iron lateral underdrains.

(3) The filter media depth is as follows:

	PARTICLE SIZE (mm)	UNIFORMITY COEFFICIENT	DEPTH (m)
Anthracite	0.87 - 0.92	1.7	0.381
Sand	0.35 - 1.41	1.3-1.5	0.317
Sand	1.19 - 2.38	1.3-1.5	0.051
Gravel	3.17 - 6.35		0.051
Gravel	6.35 - 12.7		0.051
Gravel	12.7 - 19.1		0.089

FILTERS 5-6 (1968)

	W (m)	L (m)	(1) D (m)	SURFACE AREA (m^2)
Individual	6.4	12.8	2.7	81.9
TOTAL				163.8

NOTES:

(1) D (m) is depth of water in the filter box in metres.

(2) Filters 5-6 have Leopold clay underdrains.

(3) The filter media depth is as follows:

	PARTICLE SIZE (mm)	UNIFORMITY COEFFICIENT	DEPTH (m)
Anthracite	0.87 - 0.92	1.7	0.381
Sand #2	0.35 - 1.41	1.3-1.5	0.317
Sand #1	1.19 - 2.38	1.3-1.5	0.051
Gravel	3.17 - 6.35		0.076
Gravel	6.35 - 12.7		0.076
Gravel	12.7 - 25.4		0.102
Gravel	25.4 - 38.1		0.203

(j) Filters (cont'd)

Raw Water Turbidity Range (FTU)	0.6 - 10.0 These readings are obtained from the chart in the control room which continuously records the raw water turbidity.
Effluent Turbidity Range (FTU)	0.01 - 0.25 These readings are obtained from the chart in the control room which continuously records the plant effluent turbidity.
Length of Run	24 hours. The Kingston plant may change the backwash criteria to head loss in the near future.
Headloss (Clean Bed/Dirty Bed)	0.150 m - 1.5 m

Flow Rate

Flow (ML/d)	Flow * Split	Filtration Rate (m/hr) Filters 1-4	Filtration Rate (m/hr) Filters 5-6
118	72/46	9.2	11.7
50	31/19	3.9	4.8

Backwash Flow: Filters 1-6: High 28 m/hr
Low 14 m/hr

Water Filtered/Cycle: Filters 1-4: 85 - 225 m^3/m^2 range
Filters 5-6: 85 - 250 m^3/m^2 range

Backwash Water/Wash: Filters 1-4: 3.42 - 3.79 m^3/m^2 range
Filters 5-6: 3.42 - 3.66 m^3/m^2 range

* Filters 1-4/Filters 5-6
Filters 1 to 4 inclusive are rated at 18 ML/d each, and Filters 5 and 6 are rated at 23 ML/d each. For the purposes of this report, it has been assumed that the flow splits in the same proportion at the lower plant flow rates.

Filters 1-4 have cast iron lateral underdrains and Filters 5-6 have Leopold clay underdrains. The Kingston Public Utilities Commission has not observed any significant difference in the operation of the two types of underdrains.

(j) Filters (cont'd)

The backwash system consists of one centrifugal pump located in the filter pipe gallery which draws water from the filter clearwell. The nameplate data for the wash pump is 45 ML/d at about 11 m of head. There is an emergency backwash system, which draws water from the high lift pumps. This standby system would only be used under extraordinary conditions, and constitutes a reasonable economic compromise.

(k) Clearwells

The clearwells and reservoir are constructed of concrete.

Clearwell under Filters 1-4	1.5
Clearwell under Filters 5-6	0.75
Reservoir	4.0
TOTAL	6.25 ML

(l) High Lift Pumping

The pumping station has four high lift pumps, which draw water from a concrete pipe suction header. The two standby diesel pumps draw water from a concrete suction well.

All pumps are horizontal centrifugal. The two diesel pumps are used during power failures or high water demand periods. The diesels are run once a week as a maintenance routine.

PUMP NO.	TYPE	CAPACITY (ML/d)	POWER (kW)
1	Electric	19.5	187
2	Electric	19.5	187
3	Electric	23.6	224
4	Electric	31.8	298
Stand by	Diesel	22.7	227
Stand by	Diesel	22.7	227
TOTAL INSTALLED		139.8	
FIRM CAPACITY		108	

The firm capacity assumes the loss of the largest pump.

(m) Backwash Treatment

Presently, the plant has no waste treatment facilities. The backwash water is discharged directly into Lake Ontario. The quantities of solids discharged into the lake and possible treatment methods are is discussed in more detail in the supplemental WPOS waste treatment report and other Ministry of the Environment studies.

(n) Settling Tank Waste

The settling tank sludge is also discharged into Lake Ontario. Again, the quantities of solids discharged into the lake and possible treatment methods are is discussed in more detail in the supplemental WPOS waste treatment report and other Ministry of the Environment studies.

The settling tanks are cleaned once every six months as part of a regularly scheduled maintenance program. The Kingston Public Utilities Commission noted that the sludge does not accumulate to significant levels when the tanks are cleaned regularly.

C.3 Chemical Systems

(a) Disinfectant

Chlorine is stored as a liquid in 0.9 tonne cylinders.

Application points:

Pre- Intake pipe

Post- Chlorine could be added to the filtered water conduit, but usually no post chlorine is added.

Equipment:

Pre- 2 - 909 kg/d gas Chlorinators
1 - continuous chlorine analyzer
1 - scale

The total feed rate for the chlorinator could be 1818 Kg/d, for a maximum dosage of 15.4 and 36.4 mg/L for 118 and 50 ML/d, respectively.

(b) Coagulant

Liquid alum is stored in one concrete storage tank which is divided into two sections. The tank has a PVC liner. Each of the two sections have capacities of 32,000 L. The tanks can be isolated by closing a valve between them, but normally the valve is open.

Alum is fed directly from the storage tank with two single-head diaphragm metering pumps. The pumps are BIF Model 1731-33-9010 metering pumps, each having a maximum capacity of 416 L/h. The maximum dosage capacity with both pumps operating is 110 and 260 mg/L for 118 and 50 ML/d, respectively. The speed is flow paced with the summated raw water time pulse signal. The pumps have a manual/auto stroke adjustment.

The alum is applied at the discharge headers of the low lift pumps.

(c) Fluoride

Fluoride is not added at the Kingston plant.

(d) Dechlorination

Sulphur dioxide is stored as a liquid in 0.9 tonne cylinders.

The application point is at the clearwell outlet.

Equipment:

1 - 45 kg/d sulphonator
1 - Continuous chlorine analyzer for compound loop control of sulphur dioxide feed based on chlorine residual.

The total feed rate of the sulphonator could be 45 kg/d, for a maximum dosage of 0.38 and 0.9 mg/L for 118 and 50 ML/d, respectively.

C.4 Standby

In the event of a power failure at the Kingston Water Treatment Plant, water can be treated, although the capacity is reduced due to pumping constraints. One 115 kW diesel generator supplies power to the instruments, lights and chemical feed systems. Two of the low lift pumps can be switched from electric to diesel power and there are two standby diesel-powered high lift pumps. The pumps and their capacities are listed below:

PUMPS	CAPACITY (ML/d)	POWER (kW)
Low Lift		
#1	50	90
#2	77	150
High Lift		
Standby Diesel	22.7	227
Standby Diesel	22.7	227

C.5 Drawings

(a) Site Plan

Following is a site plan of the Kingston Water Treatment Plant.

(b) Process and Piping Diagram

A process flow and piping diagram was not available from the record drawings.

(c) Block Schematic

Following is a block flow diagram of the Kingston Plant.

(d) Photographs

Following is a series of photographs to illustrate major components and chemical feed systems.

SECTION D
PLANT OPERATION

FROM LAKE ONTARIO

FLOW PARAMETERS BASED ON 118 ML/d

INTAKE

1949 INTAKE
- 750 mm DIAMETER STEEL PIPE, 366 m LONG, CAPACITY = 90.9 ML/d

1976 INTAKE
- 1200 mm DIAMETER, 824 m LONG, INTAKE PIPE
- 153 m OF REINFORCED CONCRETE AND 671 m OF STEEL PIPE
- CAPACITY = 250 ML/d

SURGE WELL

- CYLINDRICAL CONCRETE SURGE WELL, 1.4 m DIAMETER, 4.6 m DEEP.

PRECHLORINATION

- 2 909 kg/d CHLORINATORS
- 1 CONTINUOUS CHLORINE ANALYZER
- 1 SCALE
- DOSAGE RANGE: 1.0 – 2.2 mg/L
- EQUIPMENT CAPACITY: 0 – 15.4 mg/L

TRAVELLING WATER SCREENS

- 2 TRAVELLING WATER SCREENS, 8.3 m x 1.5 m x 7.3 m DEEP.
- MESH IS 3.0 mm DIAMETER GALVANIZED STEEL WIRE WITH 13 mm OPENINGS.

LOW LIFT PUMPING STATION

NO.	TYPE	CAPACITY (ML/d)	HEAD (m)
1	ELECTRIC/DIESEL	50.0	8.2
1	ELECTRIC	40.9	8.2
1	ELECTRIC	50.0	8.2
1	ELECTRIC/DIESEL	77.3	8.2
	TOTAL INSTALLED	218.2	
	FIRM CAPACITY	140.9	

ALUM

- 1 63,560 L CONCRETE STORAGE TANK WITH A PVC LINER FOR LIQUID ALUM
- TWO BIF MODEL 1731-33-9010 METERING PUMPS, CAPACITIES ARE 416 L/h EACH
- DOSAGE RANGE: 5.0 – 18.4 mg/L
- EQUIPMENT CAPACITY: 0 – 110 mg/L

FLOCCULATION TANKS

- HYDRAULIC SPIRAL FLOW TANKS
- 3 SETS OF THREE CELLS
- NOMINAL SIZE 4.9 m x 4.9 m x 6.6 m DEEP
- DETENTION TIME AT 118 ML/D = 17 Min.

SETTLING TANKS

- HORIZONTAL CROSS FLOW TANKS MADE OF CONCRETE
- 3 TANKS, NOMINAL SIZE 14.9 m x 25.0 m x 5.3 m DEEP
- OVERFLOW RATE = 4.4 m/h AT 118 ML/d
- DETENTION TIME = 72 Min. AT 118 ML/d

→ SLUDGE TO LAKE ONTARIO

FILTERS

- SIX FILTERS, NOMINAL SIZE 6.4 m x 12.8 m

FILTERS 1–4 – 381 mm OF ANTHRACITE, 368 mm OF SAND, 190 mm OF GRAVEL
- CAST IRON LATERAL UNDERDRAINS
- FILTRATION RATE = 9.2 m/h AT 16 ML/d EACH FILTER

FILTERS 5–6 – 381 mm OF ANTHRACITE, 368 mm OF SAND, 460 mm OF GRAVEL
- LEOPOLD CLAY UNDERDRAINS
- FILTRATION RATE = 11.7 m/h AT 23 ML/d EACH FILTER

→ BACKWASH TO LAKE ONTARIO

CLEARWELLS AND RESERVOIR

	CAPACITY (ML)
CLEARWELL UNDER FILTERS 1–4	1.5
CLEARWELL UNDER FILTERS 5–6	0.75
RESERVOIR	4.0
TOTAL	6.25

BACKWASHING

1 54.5 ML/d @ 7.6 m

DECHLORINATION

SULPHUR DIOXIDE IS STORED AS A LIQUID IN 0.9 TONNE CYLINDERS

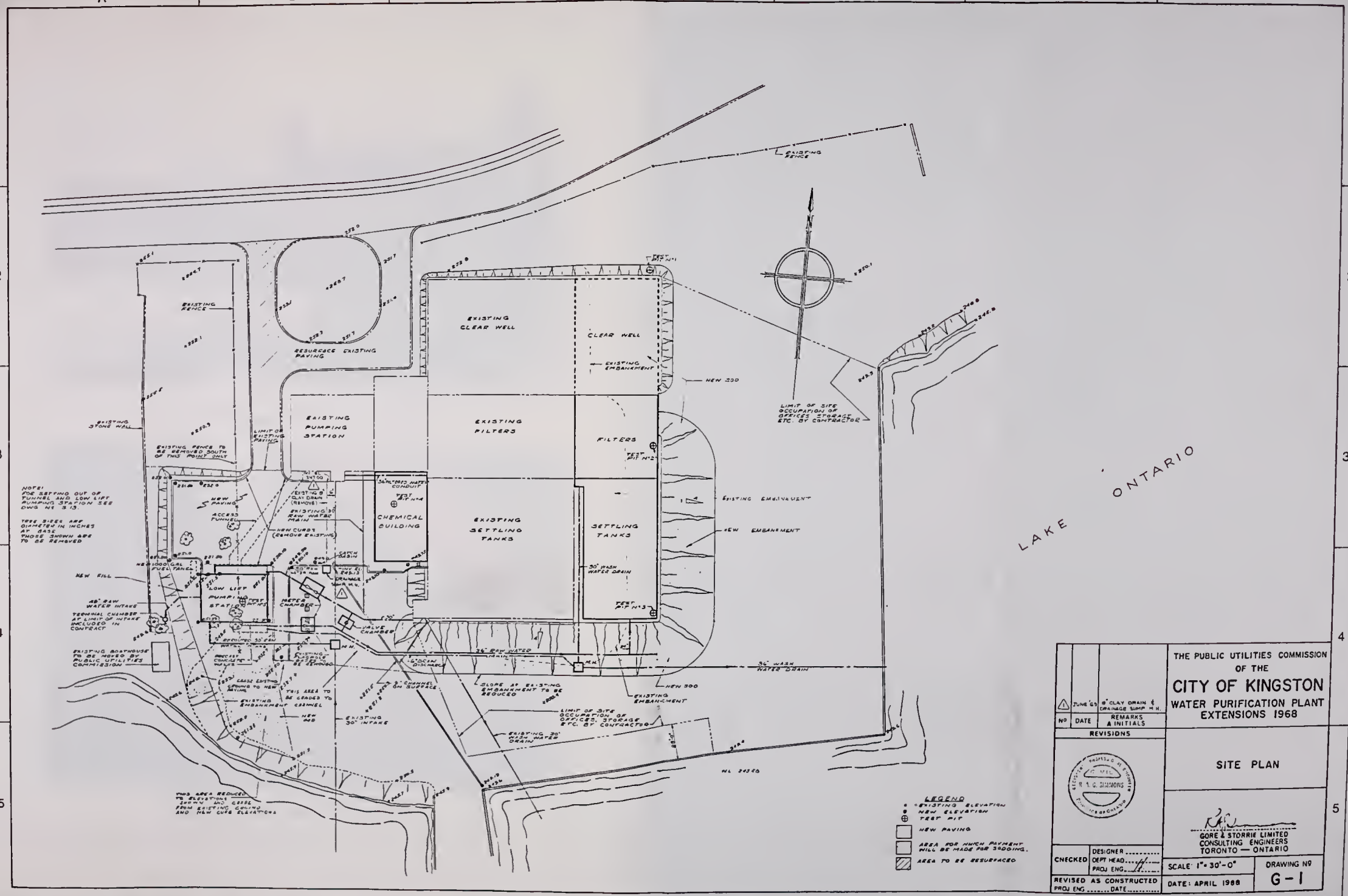
- 1 45 kg/d SULPHONATOR
- 1 CONTINUOUS CHLORINE ANALYZER FOR COMPOUND LOOP CONTROL OF SULPHUR DIOXIDE FEED BASED ON CHLORINE RESIDUAL
- DOSAGE RANGE: 0.05 – 0.35 mg/L
- EQUIPMENT CAPACITY: 0 – 0.4 mg/L

HIGHLIFT PUMPING STATION

NO.	TYPE	CAPACITY (ML/d)	HEAD (m)
2	ELECTRIC	19.5 EACH	68.6
1	ELECTRIC	23.6	68.6
1	ELECTRIC	31.8	68.6
2	DIESEL	22.7 EACH	
	TOTAL INSTALLED	139.6	
	FIRM CAPACITY	108.0	

TO DISTRIBUTION SYSTEM

MINISTRY OF THE ENVIRONMENT
WATER PLANT OPTIMIZATION STUDY
KINGSTON W.T.P.
BLOCK FLOW DIAGRAM
SEPTEMBER 1987



No	DATE	REMARKS & INITIALS
1	JUNE '69	8" CLAY DRAIN & DRAINAGE SUMP M.H.

REVISIONS

THE PUBLIC UTILITIES COMMISSION OF THE

CITY OF KINGSTON

WATER PURIFICATION PLANT EXTENSIONS 1968

SITE PLAN

GORE & STORRIE LIMITED
CONSULTING ENGINEERS
TORONTO — ONTARIO

CHECKED: DESIGNER ..... DEPT HEAD ..... PROJ ENG. ..... REVISED AS CONSTRUCTED PROJ ENG ..... DATE .....

SCALE: 1" = 30'-0"

DATE: APRIL 1968

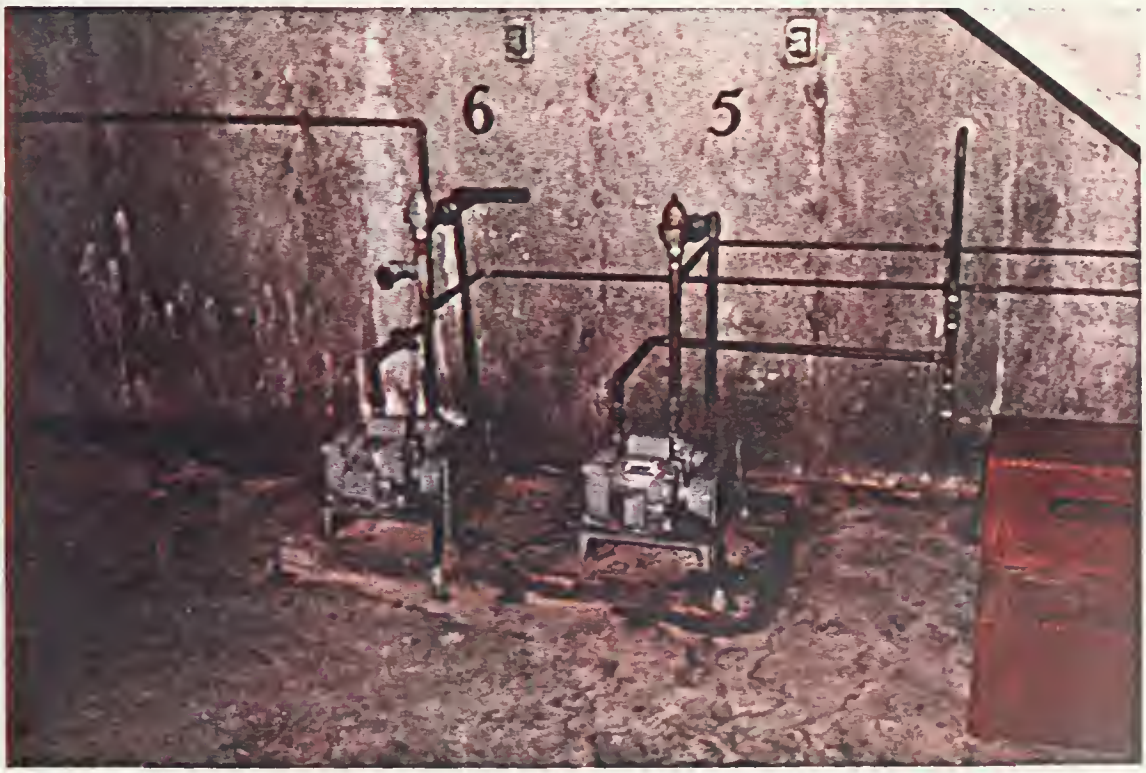
DRAWING No G-1

FILE: No 72.9-D-8869

FILTER AND ADMINISTRATION BUILDING

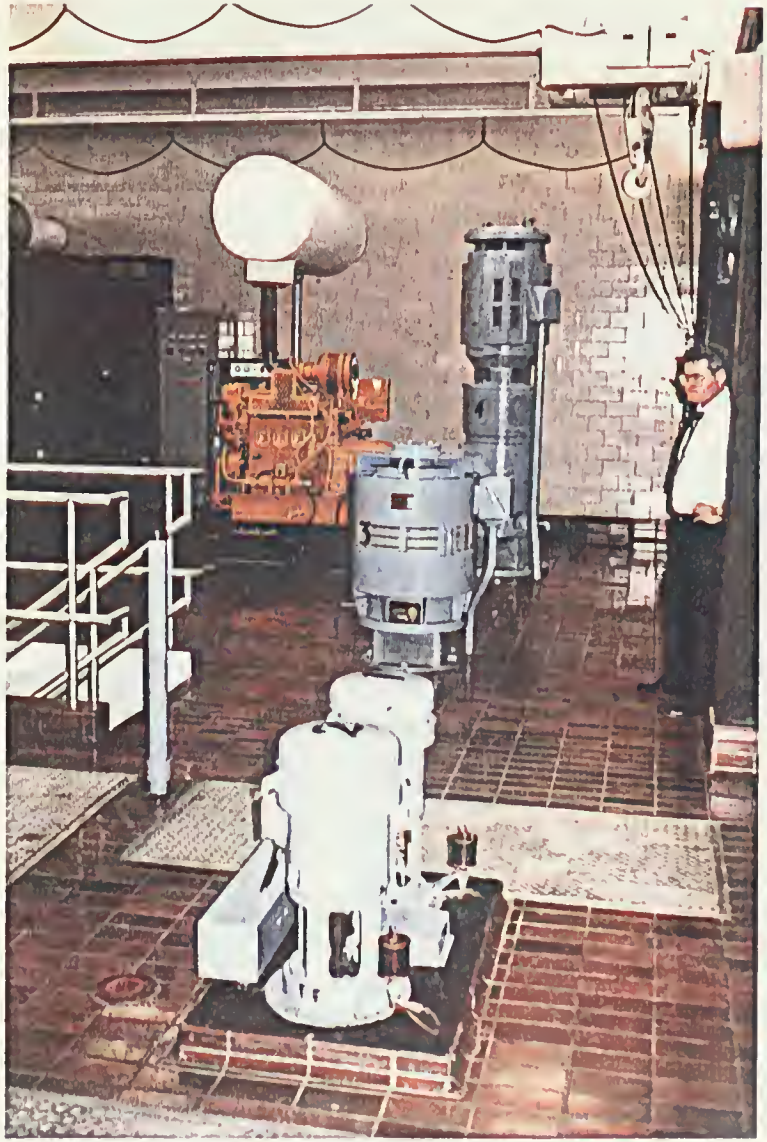
PRE-CHLORINE APPLICATION POINT

LOW LIFT PUMPING STATION



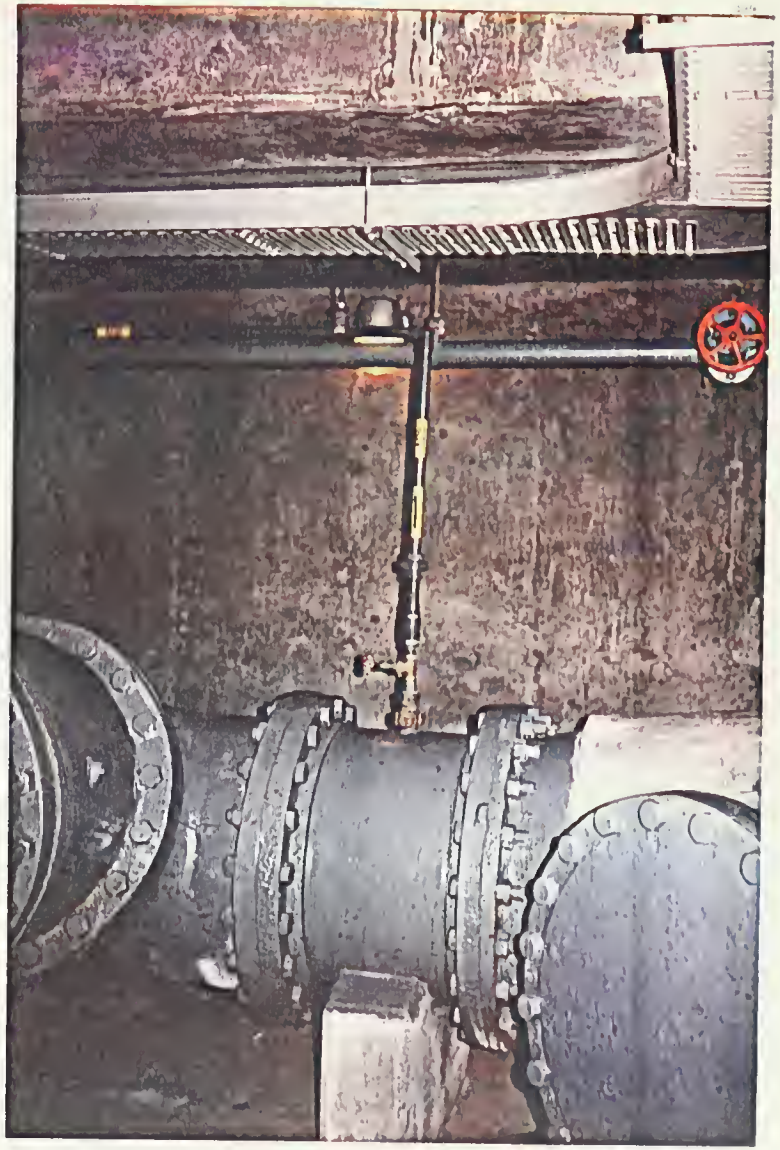
RAW WATER AND LOW LIFT WELL SAMPLE PUMPS

LOW LIFT WELL TRAVELLING
WATER SCREENS

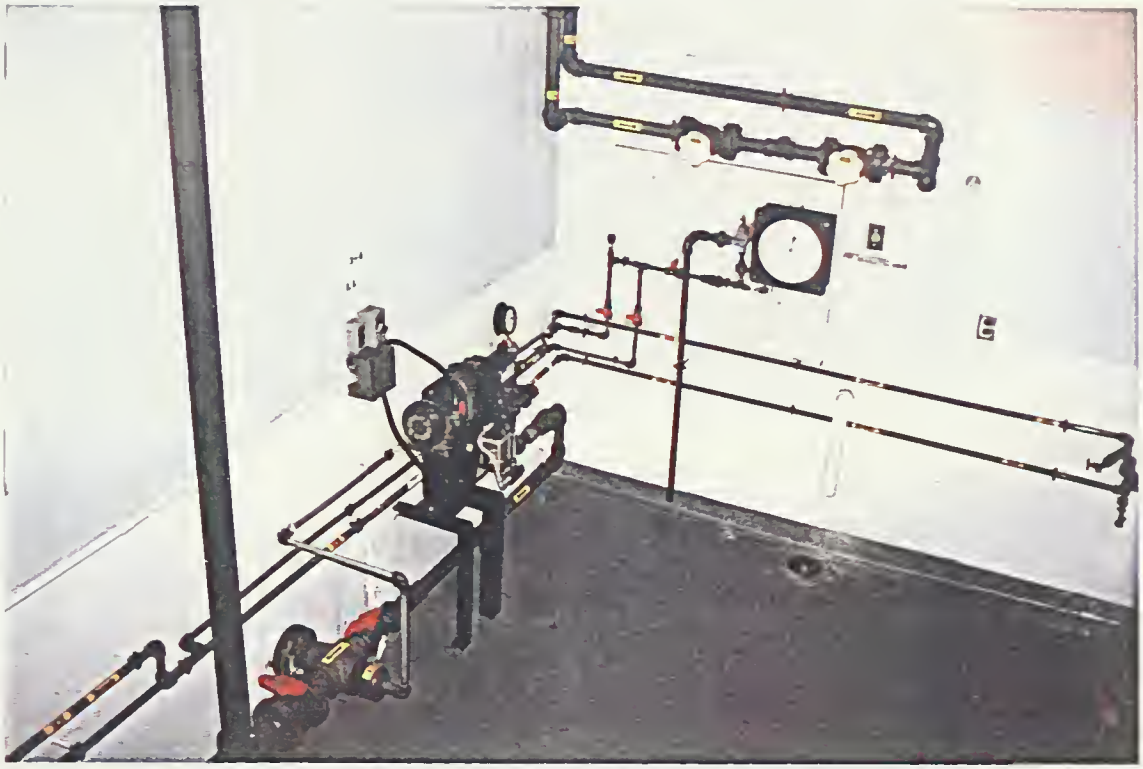


LOW LIFT PUMPS

LOW LIFT PUMPS



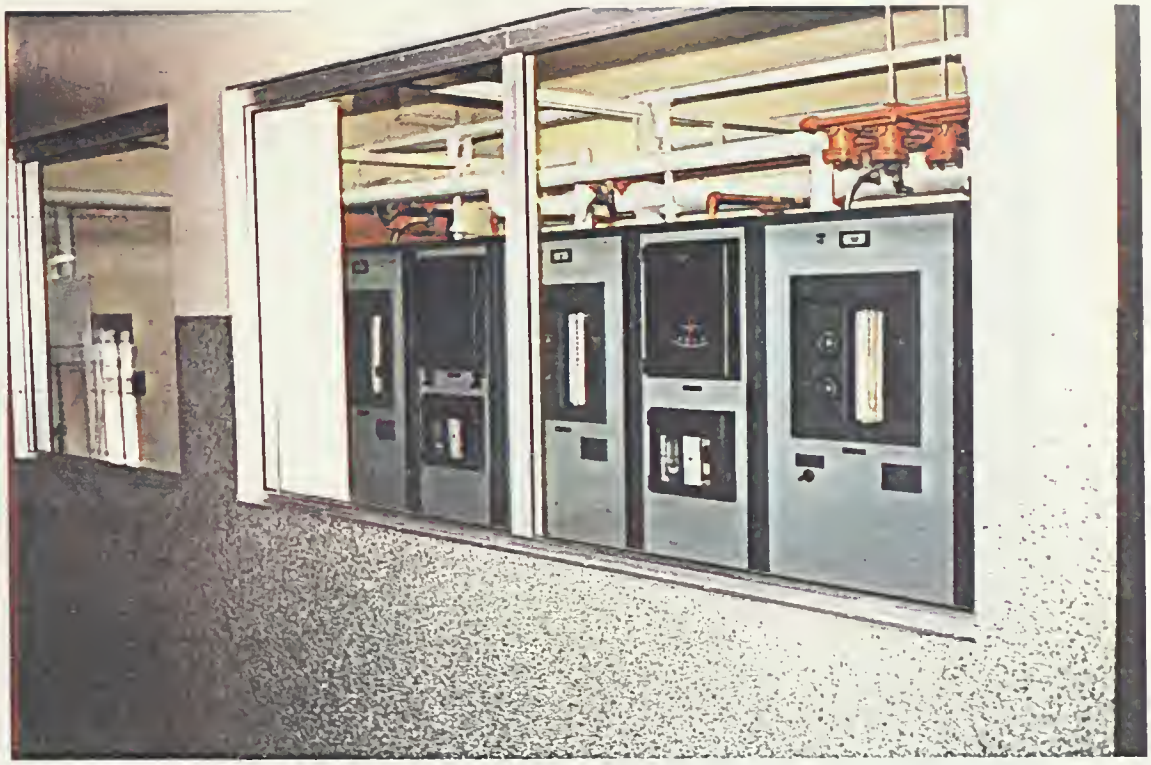
ALUM APPLICATION POINT IN LOW LIFT DISCHARGE HEADER



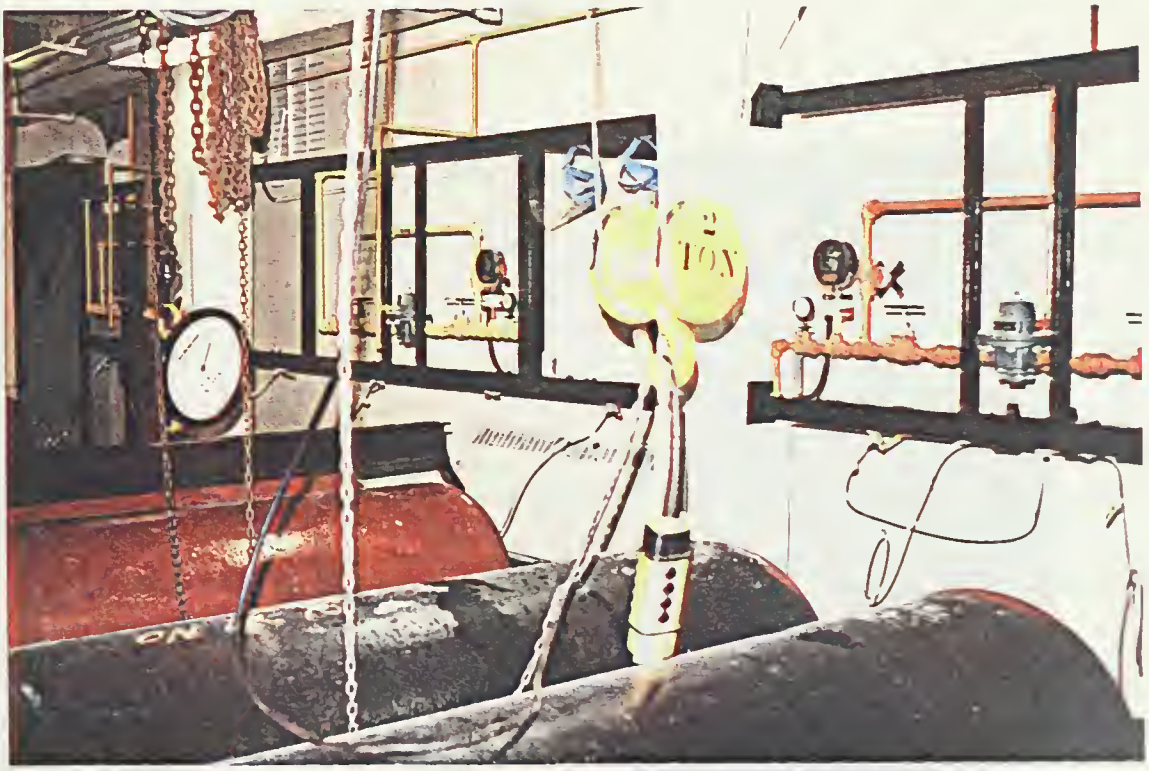
ALUM STORAGE TANK AND METERING PUMPS

LOW LIFT NORTH HEADER
FLOW TRANSMITTER

LOW LIFT SOUTH DISCHARGE
HEADER FLOW TRANSMITTER



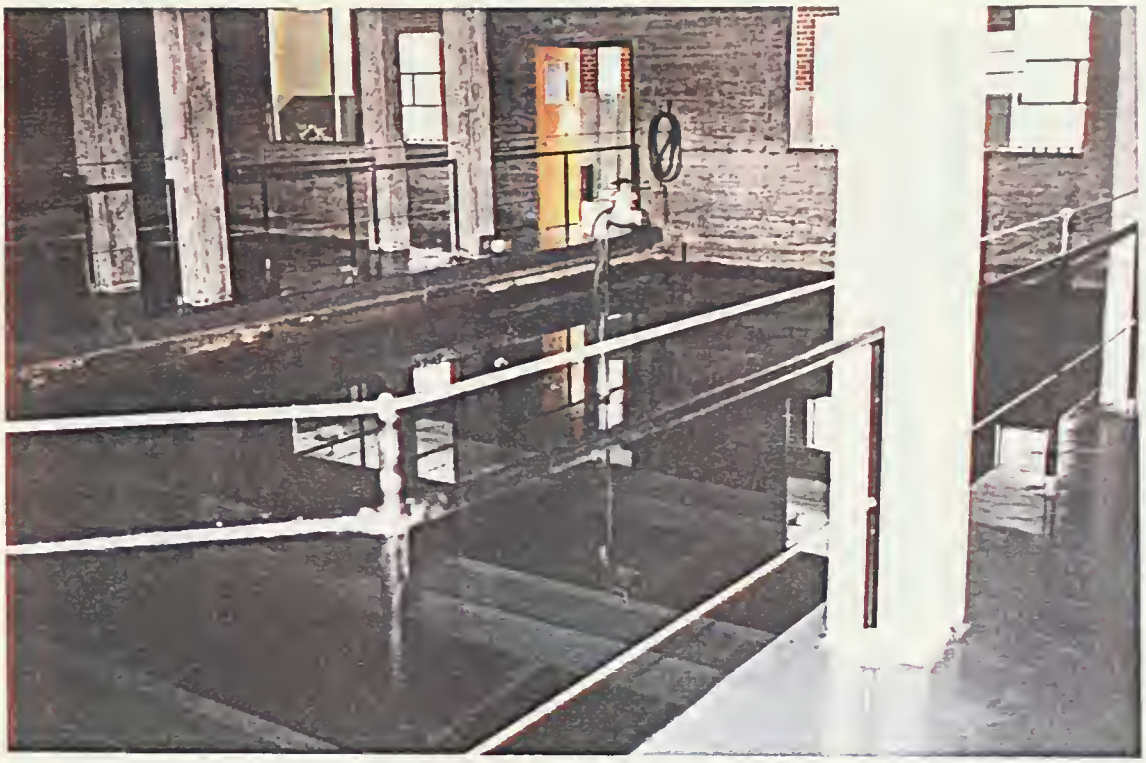
CHLORINATORS AND SULPHONATORS



CHLORINE CYLINDER STORAGE

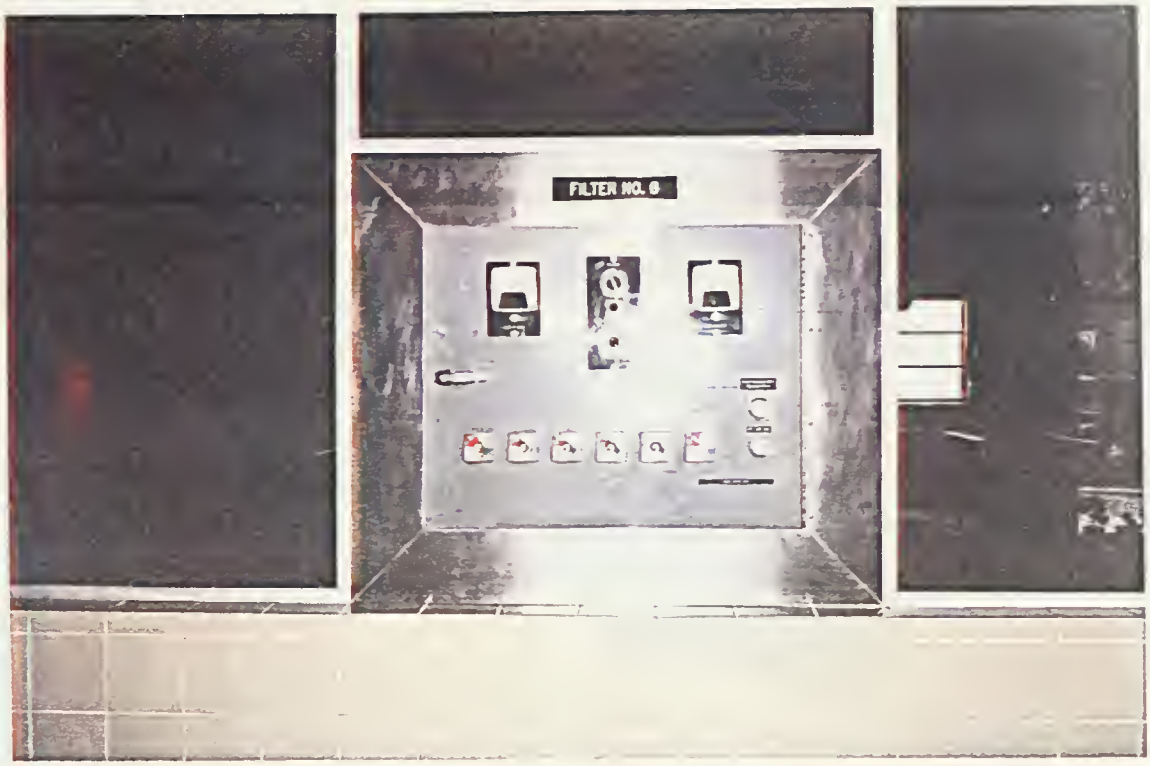
SETTLED WATER LEVEL TRANSMITTER

FILTER GALLERY

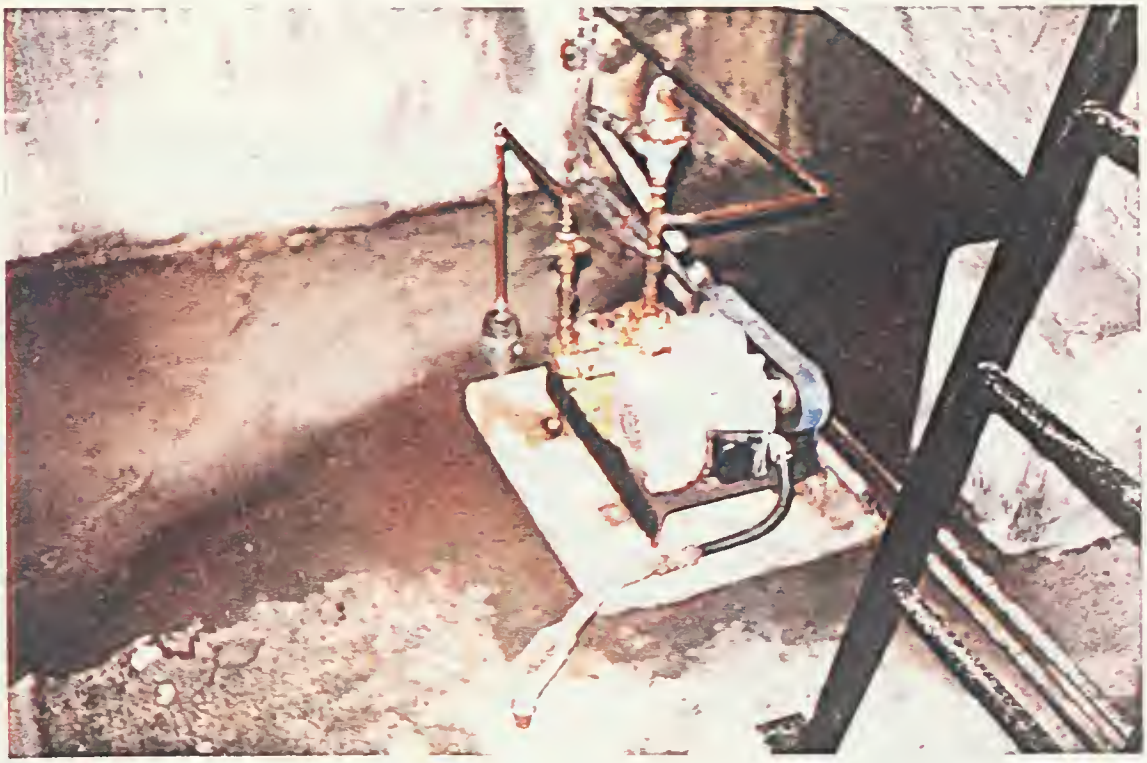


FILTER #2

FILTER #6

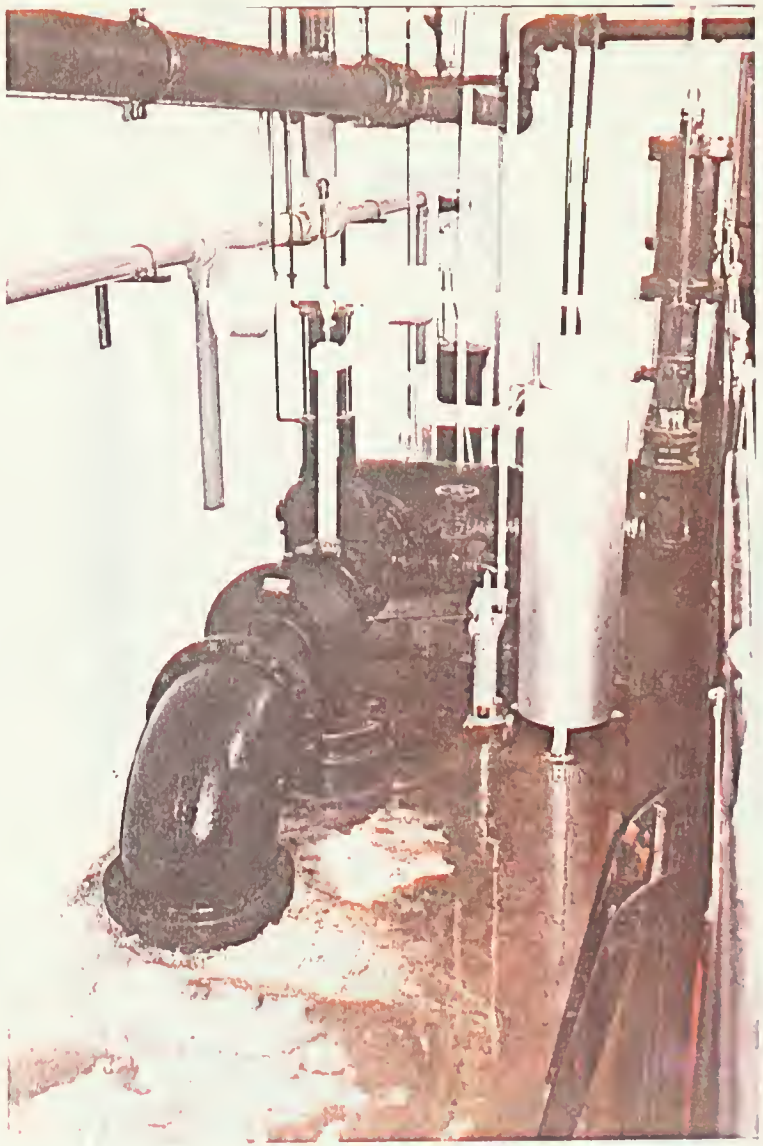


NEW FILTER CONSOLE

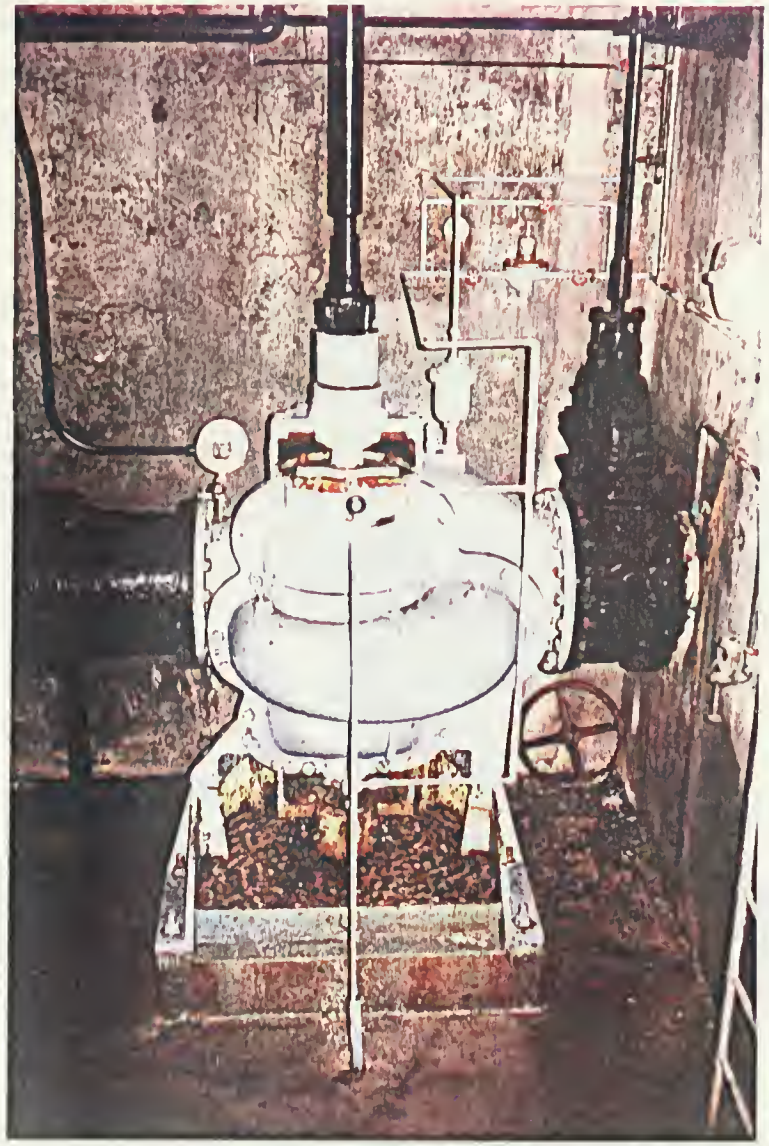


FILTERED WATER SAMPLE PUMP (TO CHLORINE ANALYZERS)

NO. 1 FILTER CONTROLS



NO. 5 FILTER CONTROLS

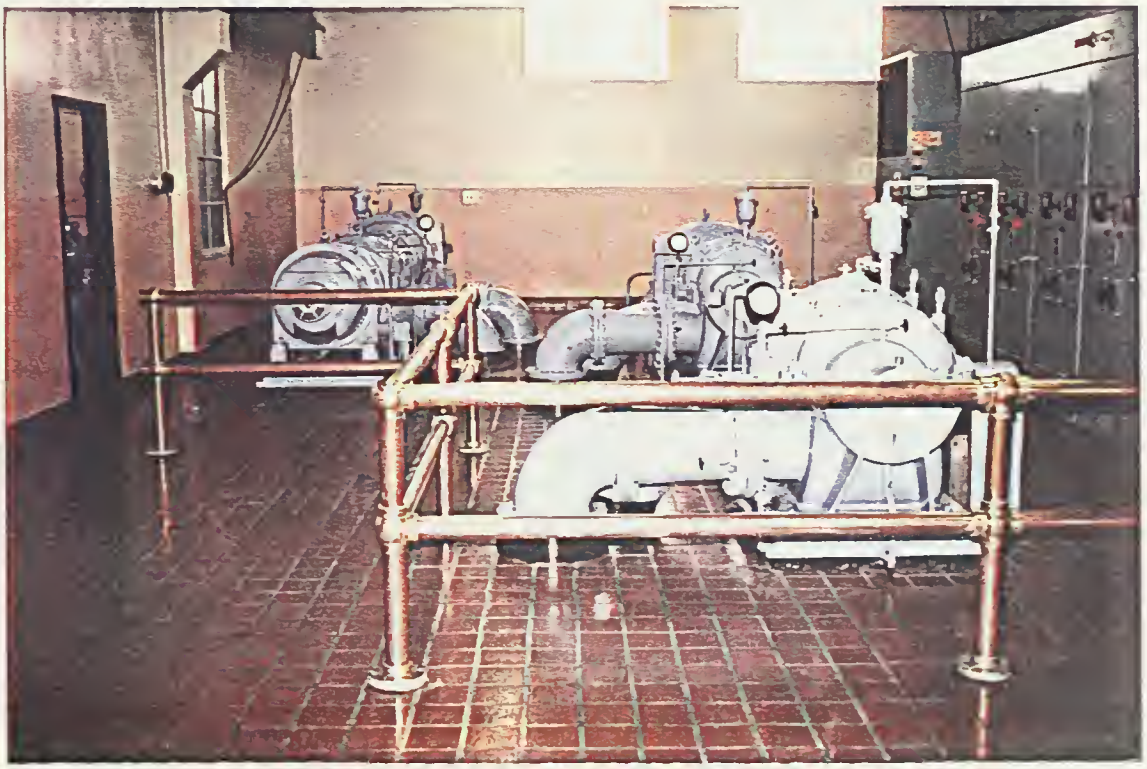


WASH WATER PUMP

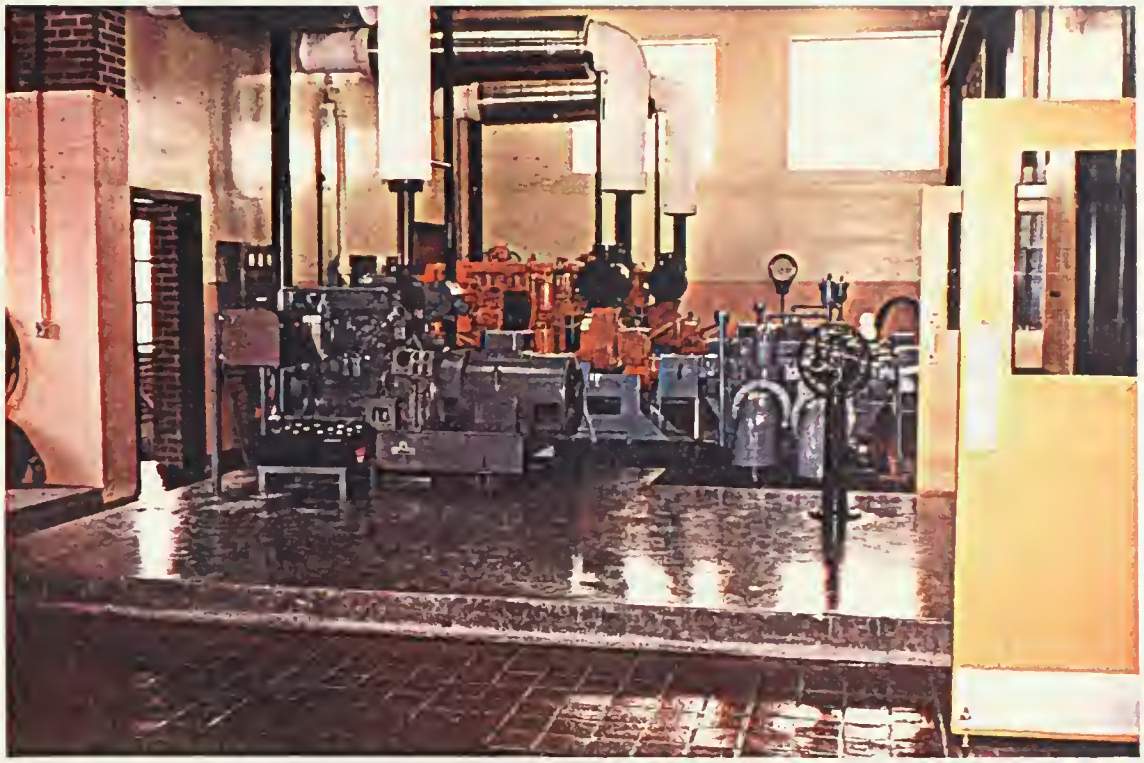
CLEARWELL LEVEL TRANSMITTER
IN OLD FILTER GALLERY

CLEARWELL LEVEL TRANSMITTER
IN NEW FILTER GALLERY

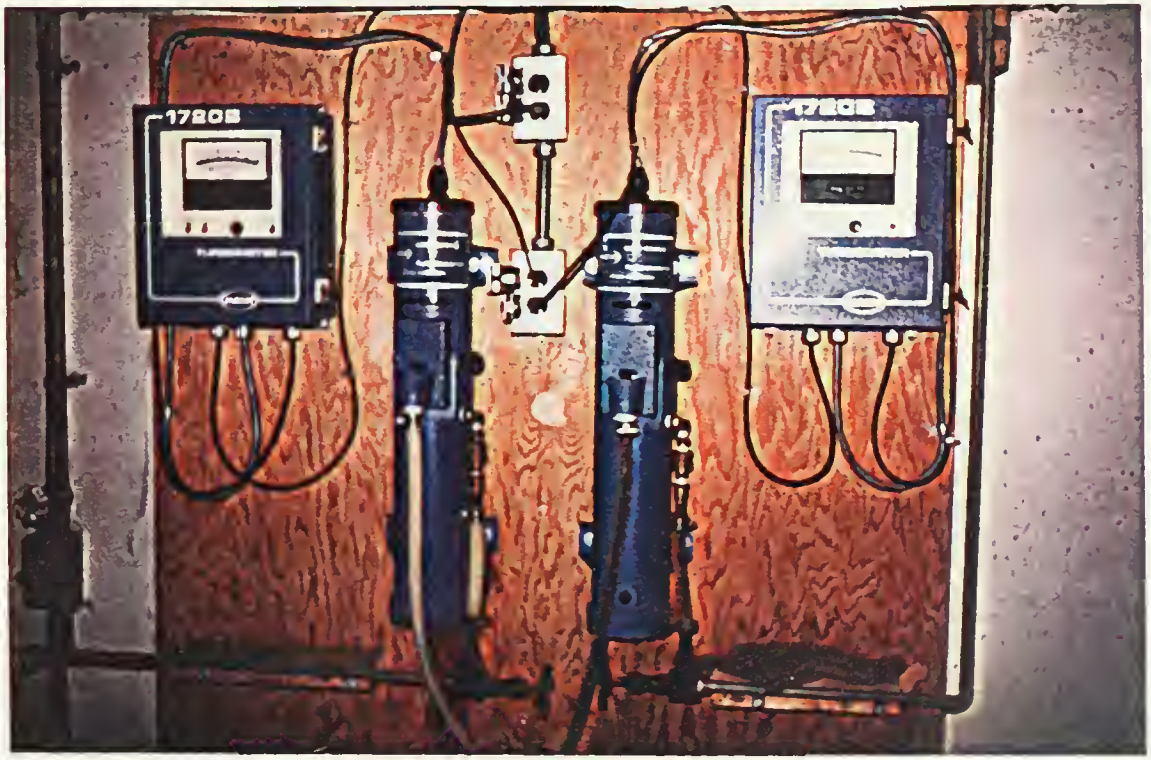
HIGH LIFT PUMPING STATION
AND CHEMICAL BUILDING



HIGH LIFT PUMPING STATION



STANDBY HIGH LIFT PUMPING STATION



PLANT EFFLUENT TURBIDIMETERS

PLANT EFFLUENT SAMPLE PUMP

SECTION D
PLANT OPERATION

D.1 Plant Operation

(a) General

The operation of this plant is very good. The plant effluent turbidity is consistently one of the lowest in Ontario with average values of less than 0.1 FTU and maximum values of 0.25 FTU. The total trihalomethanes are quite low at 34 to 76 µg/L.

(b) Flow Control

RAW WATER

The raw water flow rate is automatically set by the number of pumping units and a settled water level control system. A settled water level transmitter modulates the two raw water control valve positions to ensure a settled water level within a 150 mm band. The number of low lift pump units operating is manually set to maintain the raw water control valves within a 20 to 70 percent open position.

FILTRATION

The water plant production rate is dictated by the plant clearwell level. Filters 1 to 4, which have manual filter rate controllers, are usually set to about 75 percent of full capacity. Filters 5 and 6, which have electrically automated flow control, are usually set at about 75 percent of full capacity; but are adjusted daily to account for daily flow variations. The actual flow rate at any time is dictated by the clearwell level through a high level override control; wherein the flow rate is reduced at high levels.

HIGH LIFT PUMPING

The 3.4 ML elevated tank (Tower Street), which controls the distribution system pressure, is filled from the Third Avenue Pumping Station and reservoir. The Third Avenue reservoir (23 ML) is filled from the plant clearwell during off peak demand periods.

(b) Flow Control (cont'd)

If the pumping from the Third Avenue Pumping Station cannot fill the elevated tank, additional pumping is provided from the plant high lift pumps. An additional governing factor is that the distribution pressure is maintained between 620 kPa and 690 kPa.

(c) Filter Backwashing

The main criteria for initiating backwash procedures at the Kingston plant is time. After 24 hours of operation, the filter is backwashed. If the head loss through the filter should reach 1.5 m before 24 hours of operation, the filter will be backwashed at that time.

Generally, the filter effluent turbidity values range from 0.06 to 0.10 FTU after 24 hours of operation. The 24 hour terminal headloss values for Filters 1-4 usually range from 1.2 to 1.5 m. In Filters 5 and 6, the terminal headloss values may be as low as 0.5 m when the filters are operating at 10 ML/d each, and may be 1.3 to 1.5 m when operating at 20 ML/d each.

The filters do not have individual effluent turbidimeters; grab samples from the individual filter effluents are taken occasionally, and if the turbidity is high, the filter will be backwashed. However, the effluent turbidity rarely rises above 0.1 FTU.

The low and high backwash rates of 14 and 28 m/h provide a bed expansion of approximately 0% and 12%, respectively, at 15°C. The high wash rate should provide a higher bed expansion. As noted earlier, the volume of backwash water used during a backwash is 3.4 to 3.8 m^3/m^2. Gore & Storrie's experience indicates that a wash volume of 4.0 to 5.0 m^3/m^2 is required to adequately clean a filter bed.

Each of the filters is inspected annually. The surface condition of the media is visually inspected and the media depth is measured at 36 points in each filter.

(d) Chemical Dosage Control

There are three chemical application points in the Kingston Water Filtration Plant: the end of the intake pipe, the discharge headers of the low lift pumps, and the outlet of the clearwell.

Chlorine is added into the intake pipe; alum is added into the low lift discharge headers and sulphur dioxide is added at the outlet of the clearwell.

The most important chemical to control from a particulate removal performance view point is alum.

CHLORINE

The pre-chlorinator is flow paced from the summated raw water time pulse signal. The chlorine application point is at the end of the intake pipe, as the water enters the raw water well.

Chlorine is added to obtain a free chlorine residual of 0.4 to 0.6 mg/L in the filter effluent. A residual persists through the flocculation tanks, settling tanks and filters.

The free chlorine residual of the filtered flow to the clearwell is continuously analyzed and recorded on a chart in the control room. This information is used by the operators to manually adjust the pre-chlorine dosage. Chlorine dosage is verified by weigh scale readings of the chlorine cylinders, taken every hour.

At the present time, post chlorine is not added.

ALUM

Dosages usually vary between 7 and 11 mg/L. When the raw water turbidity is greater than 5 FTU, the alum dosage may be increased to as much as 20 mg/L.

ALUM (cont'd)

Jar tests are used only when the raw water quality is changing. The operators carry out jar tests in the lab on an irregular and as required basis during significant changes in raw water conditions.

During steady raw water conditions, the alum dosage is adjusted to suit the amount of carry over to the filters which is visually assessed by the plant operator.

The alum metering pump stroke adjustments for dosage can be manually or automatically set, and the pump speeds are flow paced with the summated raw water time pulse signal. The application points for alum are into the two low lift discharge headers, one meter servicing each header.

The alum usage is determined by measuring the level drop in the storage tank at midnight each day. Dosage calculations are made on the 24 hour usage. The 24-hour level drop when operating at the average flow rate (50 ML/d) and a dosage of 10 mg/L is approximately 40 mm. Assuming a reading error of 5 mm, the accuracy of the level measurement is approximately ± 10-15%. In Gore & Storrie's opinion, this provides a relatively reliable means of determining the daily average coagulant dosage in this case.

SULPHUR DIOXIDE

The post sulphur dioxide feeder is used to feed sulphur dioxide to the outlet of the clearwell. The sulphonator can be controlled by both flow pacing and chlorine residuals. Only the residual control is used, and this maintains a total chlorine residual of 0.4-0.6 mg/L. Dosages range from 0.10 to 0.36 mg/L.

Sulphur dioxide dosage is verified by weigh scale readings of the sulphur dioxide cylinders, taken every hour.

(e) Quality Control Testing

The following table lists pertinent information on the sample systems in use at the Kingston plant:

SOURCE	LENGTH/ SIZE (m/mm)	FLOW (L/min)		VELOCITY (m/s)		TRAVEL TIME (min)	
		Max.	Norm.	Max.	Norm.	Max.	Norm.
Raw Water (no chemicals)	85/13	3.4	2.12	0.43	0.27	3.32	5.32
Low Lift Well (after Cl2)	83/13						
Settled Water (top of filters)	65/13	4.2	2.0	0.53	0.25	2.05	4.31
Plant Effluent (filtered water before SO2)	15/13	5.5	1.4	0.69	0.18	0.36	1.42
Final Water (outside plant)	30/13	7.92	1.2	0.99	0.15	0.50	3.32

NOTE: All sample lines are 13 mm diameter copper pipe, with brass fittings in the laboratory.

The sample flow rate was determined by a time-displacement test; firstly at the normal flow rate, and secondly, at the maximum flow rate with the sample tap wide open.

The sampling lines are run at the maximum flow rate at least once a month to flush the lines and keep them free of sediment.

(e) Quality Control Testing (cont'd)

TURBIDITY

There are two continuous on-line turbidity measurements. They are:

SAMPLE POINT	TESTING INSTRUMENT
Raw Water	Hach 1720B
Plant Effluent * (before SO2)	Hach 1720B

* This turbidimeter can also be used to monitor the individual effluent turbidities of Filters 1 to 6 or to monitor the turbidity of the settled water. The normal operation is to monitor the plant effluent turbidity.

All of the above turbidity measurements are recorded continuously on charts in the control room. The operator may take a daily grab sample from the sample taps in the laboratory and measure the turbidity using the laboratory Hach 2100A turbidimeter. The grab sample turbidity is recorded on the chart along with the time of sampling. These turbidity values are also recorded in the laboratory daily log book.

In addition to the above two locations, the operator may also collect a grab sample from the settled water sampling line once every couple of weeks. The turbidity is measured with the Hach 2100A and the value is recorded in the laboratory daily log book.

As indicated above, an individual filter effluent turbidity can be monitored with the Plant Effluent Hach 1720B turbidimeter. Only one filter can be monitored at once, and the plant effluent turbidity will not be monitored at that time. Operators take grab samples from the six filter effluents and measure the turbidities with the laboratory Hach 2100A. If the effluent turbidity on one of the filters was high, the filter would be shut off and most probably backwashed to improve the effluent turbidity.

The continuous Hach 1720B turbidimeters are calibrated once every 1 or 2 weeks. These meters are cleaned as required; algae buildup on the raw water turbidimeters can be visually observed. If a discrepancy occurs between the grab sample and the continuous monitoring, the Hach 1720B will be cleaned and calibrated.

(e) Quality Control Testing (cont'd)

IN-PLANT MONITORING

The following table gives a list of the tests performed at the plant:

TEST	SAMPLE POINT	TESTING FREQUENCY	REPORTING FREQUENCY	TESTING INSTRUMENT
Cl2 Residual				
- Pre-free	Filter Effluent	Continuous	Daily high and low values recorded	W&T PP4704
- Pre-free	-Plant Effluent (before SO2) Sampling Tap	2-3/day	1/day (started in 1987)	Amp. Titration
- Post total	Plant Effluent (after SO2)	Continuous	Daily high and low values recorded	W&T PP4704
- Post total	Final Water Sampling Tap	2-3/day	1/day (started in 1987)	Amp. Titration
- Post total	Final Water Sampling Tap	1/hour	1/hour	Amp. Titration
Turbidity	Raw	Continuous	1/day	Hach 1720B
	Raw	5/week	5/week	Hach 2100A
	Plant Effluent	Continuous	1/day	Hach 1720B
	Plant Effluent	5/week	5/week	Hach 2100A
pH	Raw	5/week	5/week	Hach DR2 Spectrophotometer
	Plant Effluent	5/week	5/week	Hach DR2 Spectrophotometer

(e) Quality Control Testing (cont'd)

TEST	SAMPLE POINT	TESTING FREQUENCY	REPORTING FREQUENCY	TESTING INSTRUMENT
Temperature	Raw	Continuous	1/day	In-line probe BIF Model 231-20
	Settled	1/month	Not reported	Thermometer
	Discharge	1/month	Not reported	Thermometer
Algae Counting	Raw	1/week(1)	1/week	
Bacteriological (M-F)	Raw	5/week(2)	1/day	Membrane Filtration Apparatus
	Discharge	5/week(2)	1/day	
	3rd Avenue Res.	5/week(2)	1/day	
	PUC Service Ctr.	5/week(2)	1/day	
	Ken Allen's House	5/week(2)	1/day	
Hardness	Raw	5/week	5/week	EDTA Colourimetric Titration
	Plant Effluent	5/week	5/week	
Alkalinity	Raw	5/week	5/week	Titration to pH 4.5
	Plant Effluent	5/week	5/week	
Aluminum Residual	Plant Effluent	5/week	5/week	Hach DR2 Spectrophotometer
	Raw	5/week	5/week	
Iron, Sulphate, Chlorides, Nitrite, and Nitrate	Raw	2/month	2/month	Hach DR2 Spectrophotometer
	Plant Effluent	2/month	2/month	

(1) Algae counting conducted by MOE lab.

(2) Duplicate sampling conducted by MOE and MOH labs.

Fluoride is measured periodically at the plant using the Hach DR2 Spectrophotometer, but it is not included in the regular monitoring program since fluoride is not added at the plant.

(e) Quality Control Testing (cont'd)

The following table provides a comparison between tests conducted at the plant and tests conducted by the Ministry of the Environment Drinking Water Surveillance Program (DWSP).

DATE	pH				ALUMINUM (mg/L)			
	RAW		TREATED		RAW		TREATED	
	Plant	DWSP	Plant	DWSP	Plant	DWSP	Plant	DWSP
2 July 85	7.9	8.08	7.5	7.61				
6 Aug. 85	7.85	8.03	7.39	7.55			0.10	0.099
3 Sep. 85	7.9	7.94	7.45	7.62				
7 Oct. 85	8.15	8.25	7.6	7.66	0.025	0.033	0.08	0.10
2 Dec. 85	7.9	8.15	7.4	7.65	0.02	0.16 *	0.06	0.077
3 Feb. 86	8.1	8.13	7.55	7.69	0.03	0.028	0.07	0.065
3 Mar. 86	7.85	8.20	7.5	7.72	0.02	0.034	0.04	0.063
7 Apr. 86	8.0	8.32	7.55	8.05	0.01	0.056	0.045	0.071
5 May 86	8.0	8.35						
2 June 86	8.0	8.27	7.61	7.98	0.02	0.029	0.13	0.085
2 Sep. 86	7.5	8.38						
10 Sep. 86	7.7	8.3	7.55	8.08				
3 Nov. 86	7.9	7.91	7.6	8.17			0.05	0.13
AVERAGE	7.90	8.18	7.52	7.80	0.021	0.095	0.072	0.086

* Did not include in average.

Generally, the DWSP pH and aluminum values are slightly higher than those measured at the plant.

D.2 Operation and Process Concerns

(a) Chemical Mixing

The original alum feed points were into the suction side of the low lift pumps, but this caused problems with accumulations on the pump impellers. Alum is now added into the low lift discharge headers. Consideration has been given to the installation of in-line blenders in the headers, but the Kingston Public Utilities Commission believes that the present alum application points provide sufficient chemical mixing.

(b) High Lift Flow Metering

The venturi flow tubes may not consistently reflect the proper flows due to low flowrates. As noted earlier, the instrumentation system is checked from the differential pressure onward and is quite reliable. Some independent checks have been made of the flow using pitot tubes and these have shown that some inaccuracies may exist. Further tests should be undertaken.

(c) Wash Water Rate

As mentioned earlier, the high backwash rate of 28 m/h provides a bed expansion of approximately 12%. A high backwash rate should be 25 - 50 m/h to provide a bed expansion of 10% to 35%. This condition should be reviewed in detail.

The wash volume ranges from 3.4 to 3.8 m^3/m^2. Gore & Storrie's experience indicates that a wash volume of 4.0 to 5.0 m^3/m^2 is required to properly clean a filter bed. The backwash procedure should be investigated to determine the relative durations and rise rates of the low and high wash rates to provide an adequate backwash. The backwash must maintain the long term cleaning of the filters.

(d) Taste and Odours

Problems such as taste and odours and filter clogging algae occur infrequently.

The provision of the new intake in 1970 has lessened the occurence of these episodes. The taste and odour problems are now limited to low flow areas in the distribution system which are corrected by hydrant flushing. There has not been an incident of filter clogging algae in the last 10 years.

(e) Aluminum Residuals

As shown in Appendix A, Table 7.0, there are occasions when the aluminum residual is slightly elevated. The topic of aluminum solubility and residual is discussed further in the following section.

(f) Third Avenue Reservoir and Concession Street Elevated Tank

There are times during high demand periods that the plant experiences problems in filling the Third Avenue Reservoir. When the level in the 3.6 ML elevated tank on Concession Street becomes low, it becomes increasingly difficult to fill the Third Avenue Reservoir. During these periods, the plant operates all of its pumps all of the time instead of operating the reservoir pumps.

SECTION E

PLANT PERFORMANCE (PARTICULATE REMOVAL)

SECTION E

PLANT PERFORMANCE (PARTICULATE REMOVAL)

E.1 Turbidity Removal

(a) General

The Kingston plant must deal with the raw water conditions as shown:

Turbidity (FTU)	0.6 - 10.0
Colour (TCU)	1.5 - 9.0
pH	7.91 - 8.35
Iron (mg/L)	0.001 - 0.16
Manganese (mg/L)	0.001 - 0.048
Temperature (°C)	0.3 - 20.5

The raw water quality is good and is quite consistent all year. Considering turbidity alone, the raw water conditions would allow treatment by direct filtration (that is, a plant without settling tanks) to meet today's treated water turbidity objective.

(b) Plant Performance

OVERALL PLANT PERFORMANCE

It is usual to consider two conditions for plant operation, the maximum hydraulic flow rate (118 ML/d) and the maximum process flow rate. The maximum process condition, from the standpoint of particulate removal, occurs with the highest solids loading on the plant. At Kingston, due to the consistently good raw water quality, the plant is able to operate at the maximum hydraulic flow rate and does not have a lower maximum process flow rate.

(b) Plant Performance (cont'd)

The plant records for treated water during 1983 to 1986 can be summarized as follows:

1984 - 1986	TREATED TURBIDITY (FTU)		
	Max.	Min.	Avg.
January	0.14	0.05	0.08
February	0.25	0.05	0.07
March	0.15	0.05	0.08
April	0.25	0.05	0.09
May	0.18	0.06	0.09
June	0.18	0.07	0.08
July	0.08	0.01	0.07
August	0.15	0.06	0.08
September	0.17	0.05	0.08
October	0.12	0.06	0.08
November	0.19	0.04	0.07
December	0.20	0.05	0.08

The records confirm that the plant has consistently produced water of less than 0.3 FTU. A graph included in Appendix B as Figure 2 shows a Composite Performance Profile of Treated Water Turbidity Ranges for the period 1984 - 1986.

ASSESSMENT OF OVERALL PERFORMANCE

The turbidity guideline in the Province of Ontario is 1.0 FTU; but clearly it is important to reduce the turbidity to as low a level as practical.

The historic records of the plant have been reviewed as a means to assess plant performance under various operating conditions.

The plant records show that the plant operates extremely well from the standpoint of turbidity removal. Although the raw water turbidity is usually very low, the plant, nonetheless, produces a very low turbidity water.

E.2 Treatability Testing

(a) Jar Testing

TURBIDITY REMOVAL

Treatability testing was carried out on a raw water sample collected 2 April 1987. This raw water sample had a turbidity of 1.1 NTU. The results are included in Appendix C.

Alum or polyaluminum chloride was used in separate coagulation/flocculation/sedimentation testing, followed by filtration through a 1.2 µm membrane filter which, in Gore & Storrie's experience, emulates the performance of a dual media filter. The results of the testing demonstrate that filtration down to a turbidity of <0.2 NTU is achievable with the appropriate alum or polyaluminum chloride dosage. Both coagulants seemed to perform equally well.

ALUMINUM RESIDUAL

The use of aluminum salt coagulants (alum, polyaluminum chloride, etc.) in potable water treatment plants may lead to increased aluminum concentrations in treated water, which may result in water quality and supply problems.

There is no evidence that aluminum is physiologically harmful, and no health-related limit has been specified anywhere in the world to our knowledge. However, the perception of potential health problems associated with aluminum frequently emerges.

Water supply problems may be associated with increased aluminum concentrations in treated water. These problems include the formation of a hydrous aluminum precipitate in the distribution system which may increase turbidity and complaints about clarity. Aluminum floc in the system may interfere with the disinfection process by entrapping and protecting microorganisms. Another problem attributed to increased aluminum concentrations is deposition of aluminum hydrolysis products on pipe walls, which decreases carrying capacity. To minimize these problems, the Ontario Drinking Water Objectives (ODWO) suggest an operational guideline of <0.1 mg/L as Al in the treated water leaving the plant.

(a) Jar Testing (cont'd)

An EPA survey of 186 utilities showed that a number of plants exhibited high residual aluminum when overdosing of alum occurred. Even though some utilities surveyed stated that minimizing the alum dosage is a strategy for controlling residual aluminum, underdosing of alum appears to be just as detrimental to turbidity removal and residual aluminum control as overdosing.

Water quality problems associated with high concentrations of aluminum in finished water have led to discussion of ways to reduce residual aluminum concentrations. One method of reducing aluminum concentration is to optimize coagulation. To have optimum coagulation requires that the best coagulant, dosage, and combination of operating conditions be selected for each raw water. The optimum pH range must also be achieved since aluminum is least soluble in water in the pH range 5.5-7.0.

There are treatment plants in Ontario which are currently using residual aluminum as an "operational tool" to optimize the dosage of alum. Operational staff respond to any elevation in residual aluminum and make the necessary adjustments to the plant operation.

Aluminum solubility in water is a complex topic, but some of the most significant variables are pH, time and temperature. For pH values greater than 6.5, the aluminum residual increases directly with pH. Aluminum residual is inversely proportional to time, up to several hours, whereupon the solubility concentration remains fairly constant. The aluminum residual is directly related to temperature, but this has a fairly minor impact over the ranges encountered in natural waters. For times greater than an hour and pH's greater than about 7.4, water may contain a residual concentration greater than 0.1 mg/L.

For the aluminum residuals and pH values found in the waters at the plant, the results are consistent with general experimentally determined values. Therefore, it is not surprising to find aluminum concentrations greater than 0.1 mg/L.

(a) Jar Testing (cont'd)

Kingston's treated water aluminum residuals have sometimes been above the guideline of 0.1 mg/L, therefore, jar tests were run to check aluminum residual. In Gore and Storrie's opinion, the benefits associated with changing the alum dosage to control the aluminum residual, over and above those for turbidity control, is not warranted.

A minimum of daily monitoring of aluminum residual and pH leaving the plant is recommended by the Ontario Ministry of the Environment. An acceptable method of aluminum analysis should be used. Frequent examination of this data and Drinking Water Surveillance Program (DWSP) data will supply the needed information on the chemistry and fate of aluminum following water treatment to help operating authorities minimize the concentration of aluminum in the treated water.

COAGULANT DOSAGE(S)

From the test work conducted as part of this optimization study, Gore & Storrie believes that the optimum filter effluent quality is achieved with an alum dosage of about 5 to 10 mg/L for the raw water conditions experienced by the plant. In striving for excellence, the Ministry of the Environment considers the optimum alum dosage to be higher, based on types of floc formation and settleability of floc to achieve low turbidity levels before the filters, resulting in the lowest possible filtered water turbidity and residual aluminum levels in the filtered water.

E.3 Optimum Removal Strategies

(a) Flash Mixing and Coagulant Addition

As noted in previous sections, the plant presently applies the alum into the raw water discharge headers. The previous alum application points were into the suction sides of the low lift pumps, but this resulted in problems with accumulations on the pump impellers.

(a) Flash Mixing and Coagulant Addition (cont'd)

The indications to date with this application point are quite favorable, however, consideration should be given to the installation of in-line blenders to allow for optimum coagulant addition.

(b) Flocculation, Mixing, and Sedimentation

All of the flocculation and sedimentation tanks are used at most times. Since the level of mixing in the flocculation tanks is dictated by the flow rate, there may be some benefits obtained from isolating the pretreatment sections of the plant. The resident time afforded by having all tanks operational is increased at lower flows; thus the mixing system tends to compensate for the reduced flow rates. In addition, the settling tank performance is inversely dependent on the flow rate; therefore, this unit operation tends to also compensate for reduced mixing levels at lower flow rates by becoming more efficient. However, there are bounds to how low the flow rate can be before overall performance is affected.

It is Gore & Storrie's opinion that, at this time, there is some merit to investigating the improvement which would result from maintaining high flows and consistent "G" values in the flocculation tanks.

(c) Filtration

The filtration rates of Filters 5 and 6 are set at constant rates, while the rates of Filters 1-4 are dictated by the demand for clearwell water. The latter procedure is stressful for the filters since any change of flow rate may reduce the filters' removal performance. Therefore, from the standpoint of particulate removal, the ideal procedure would be to operate all filters with a constant flow rate to satisfy some long-term demand. This procedure requires that the clearwell level rise and fall to offset the difference between production and demand flow rates.

SECTION F

PLANT PERFORMANCE (DISINFECTION)

SECTION F
PLANT PERFORMANCE (DISINFECTION)

F.1 Disinfection

At the Kingston Water Treatment Plant, disinfection is carried out by adding chlorine to the exit of the intake pipe to achieve a free residual of approximately 0.4 to 0.6 mg/L in the filter effluent. Data shown in Tables 3.0 and 3.1 in Appendix A show that the total monthly average chlorine dosage ranged from 0.6 to 2.1 mg/L.

After screening, flocculation, settling, and filtration, sulphur dioxide is applied at the clearwell outlet to obtain a total chlorine residual of 0.4 to 0.6 mg/L. The use of sulphur dioxide may help to reduce THM levels by reducing the chlorine concentration to time relationship.

F.2 Disinfection Efficiency

Tables 6.0 to 6.2 in Appendix A summarize the available raw and treated microbiological data for the Kingston plant.

Fecal coliforms, as well as total coliforms, were found in the raw water at levels in excess of guidelines, indicating that disinfection is necessary.

The data show that the microbiological quality of the treated water leaving the plant is good, as indicated by total coliform and fecal coliform measurements. Although the plant effluent total chlorine residuals are maintained at relatively low levels, 0.4 to 0.6 mg/L, the disinfection efficiency is good. The Kingston plant reports that a free chlorine residual is maintained throughout the distribution system. In Gore & Storrie's opinion, the chlorine feed system and the operations policy for disinfection of the water are adequate.

F.3 Chlorinated By-Products

TRIHALOMETHANES

Trihalomethanes (THM's) are the most widely occurring organics found in drinking water, and they also appear at the highest concentrations. The principal source of THM's in drinking water is the chemical interaction of chlorine added for disinfection, with humic and fulvic substances that occur naturally in the raw water. There is some evidence that THM's are carcinogenic. The Ontario Drinking Water Objectives for THM's is 350 µg/L.

Based on the data available on THM's (see Table F.1) for the Kingston Water Treatment Plant, the levels of THM's found in treated water are well under the Ontario Drinking Water Objectives of 350 µg/L (0.35 mg/L). Total THM values were determined by the direct aqueous injection method up to March 1985, and subsequent samples, by the purge and trap method. The treated water TTHM values ranged from 34 to 76 µg/L, with an average value of 44 µg/L. Therefore, it is Gore & Storrie's opinion that little should be done, at this time, to assess methods of reducing the THM's to lower levels.

TOTAL ORGANIC HALIDES

The terms of reference require consideration be given to the reduction of chlorinated by-products in the treated water. There was no complete set of information on the total concentrations of all organohalogen compounds.

It is Gore & Storrie's opinion that a broader measurement of chlorinated by-products and other organic contaminants should be considered and possibly a surrogate measurement should be utilized. Although there is not general agreement in the field which surrogate measurement should be used, the measurement should report the total of all the organic halogen compounds.

TABLE F.1

Trihalomethane Data for Kingston WTP

		1984		1985		1986		
		R	T	R	T	R	T	D(a)
JAN	Chloroform, µg/L				21			
FEB	($CHCl_3$)				23		11	
MAR			15		16		14	
APR			21				23	
MAY					31		39	
JUN							24	17/18
JUL			18		28		23	14/17
AUG			22		26		20	15/16
SEP			19		30		18	11/-
OCT			31		34		15	12/15
NOV			19		25			10/13
DEC					20		22	15/14
JAN	Bromodichloromethane,							
FEB	µg/L ($CHBrCl_2$)						9	
MAR							11	
APR							13	
MAY							9	
JUN							8	7/9
JUL			4		14		15	10/10
AUG					14		14	11/12
SEP			4		17		12	9/-
OCT			6		21		11	9/11
NOV			6		15			8/10
DEC					12		12	9/8
JAN	Chlorodibromomethane,				5			
FEB	µg/L ($CHBr_2Cl$)				4		13	
MAR					6		24	
APR							13	
MAY					5		3	
JUN							2	2/3
JUL					5		9	6/6
AUG					13		6	5/5
SEP					17		6	4/-
OCT					21		2	3/2
NOV					17			ND/ND
DEC					10		5	3/4
JAN	Bromoform, µg/L							
FEB	($CHBr_3$)							
MAR								
APR								
MAY								
JUN								ND/ND
JUL								ND/ND
AUG								ND/ND
SEP								ND/ND
OCT								ND/ND
NOV								ND/ND
DEC								ND/ND

TABLE F.1 (cont'd.)

		1984		1985		1986		
		R	T	R	T	R	T	D(a)
JAN	Total THM's, µg/L				40			
FEB					40		33	
MAR					34		49	
APR							49	
MAY					36		51	
JUN							34	26/30
JUL					47		47	30/35
AUG			38		53		40	31/33
SEP			37		64		36	24/-
OCT			56		77		28	24/28
NOV			40		57			18/23
DEC					52		39	26/27
AVG.	Total THM's, µg/L		40		50		40	27
RNG.	Total THM's, µg/L		37-56		34-76		28-51	18-35

R = Raw water
T = Treated water
D = Distributed water
(a) = 26 Morenz Cr./65 Michael Grass Cr.
ND = Not detected

SECTION G

SHORT AND LONG-TERM MODIFICATIONS

SECTION G
SHORT AND LONG-TERM MODIFICATIONS

G.1 Description

This section includes feasible short and long-term process modifications required to approach optimum disinfection and particulate removal. It is important to understand that optimization of selected process steps may be in conflict with other aspects of the plant, such as staffing and budgeting costs. Estimated costs for each recommendation are also included.

The following short and long-term recommendations were provided, discussed, reviewed, and agreed upon at the plant site meeting.

We have assigned costs for each of the recommended works. Clearly, these costs may be reduced if the Kingston Public Utilities Commission carries out the work.

G.2 Flash Mixing

There are two mechanisms of mixing of chemicals into the main process stream: blending and flash mixing. Blending consists of the distribution of chemicals uniformly throughout the body of the process stream, and is characterized by relatively high velocity gradients of greater than 200 sec^{-1} for periods up to several minutes. Flash mixing addresses the coagulation concept that blending must occur within a very short period of time, a matter of seconds, and this requires very high velocity gradients of greater than 1000 sec^{-1}. It is important to recognize the difference between these two concepts and their process implications. Blending mixing is to ensure that the process components will behave uniformly. Flash mixing has been espoused by some researchers in water chemistry as improving the coagulation process.

There is no flash mixing at the Kingston Water Treatment Plant.

G.2 Flash Mixing (cont'd)

It is recommended that laboratory tests be conducted to determine the relative merits of flash mixing for the various flow and water quality conditions at the plant. A laboratory test procedure could be developed by the Ministry of the Environment or a consultant.

This work could be carried out at any time. The cost of the study would be approximately $10,000.

G.3 Isolation of Flocculation Tanks

Since the level of mixing in the flocculation tanks is proportional to the flow rate, there may be some benefit obtained by shutting off groups of flocculation tnaks. Each group of flocculation tanks feeds two settling tanks; therefore, shutting off one group of flocculation tanks also shuts off the associated settling tanks.

It is recommended that the operation of the flocculation tanks at various flow rates be compared.

This plant-scale work should be carried out during the winter, when the overall plant flows are lower. The cost of this recommendation is minimal.

G.4 Filtration Rates

The filtration rates of Filters 1-4 are dictated by the demand for clearwell water. This procedure is stressful for the filters since any change in flow rate can reduce the filters' removal performance. From the standpoint of particulate removal performance, the ideal procedure would be to operate all filters with a constant flowrate to satisfy some long-term demand.

It is recommended that plant scale tests be conducted to determine the magnitude of improvement which would result from maintaining lower constant filter flow rates.

This work could be conducted at any time. The cost of the study would be $10,000 to $15,000.

G.5 Filter Effluent Turbidimeters

Elevated plant effluent turbidities can be minimized or eliminated by monitoring individual filter effluent turbidities. The problem filter can be identified and backwashed before the plant effluent turbidity rises. The current instrumentation at the Kingston plant allows turbidity monitoring of any filter effluent or the combined filter effluent, but only one location at one time.

To optimize the plant particulate removal performance, it is recommended that filter effluent turbidimeters be installed on the six filters.

This work should be conducted as soon as possible. The cost of six turbidimeters would be $15,000 to $20,000.

G.6 Turbidity Profile

Presently, at the Kingston Water Treatment Plant, records of raw and filtered water turbidity are kept. It is believed that a Turbidity Profile through the plant is a useful operating tool which provides a good set of data for the purpose of plant performance review.

It is recommended that a turbidity profile, consisting of raw, settled, and filtered turbidities, be recorded for all filters. The profile should be recorded on a minimum of once every four hours.

This recommendation should be implemented as soon as possible.

G.7 Filter Cleaning

Previous experience has shown that a backwash volume of 4.0 to 5.0 m^3/m^2 of filter area adequately cleans a filter bed. The wash volume used at the Kingston plant is lower at 3.4 to 3.8 m^3/m^2, however, Kingston backwashes its filters every 24 hours, independent of the accumulated headloss. Sufficient cleaning may be obtained with these lower wash volumes since the accumulated solids in the filters may be less. The filter maintenance program does not indicate a deterioration of the filter beds.

G.7 Filter Cleaning (cont'd)

The low and high backwash rates of 14 and 28 m/h provide bed expansions of 0% and 12%, respectively, at 15°C. A high backwash rate should be 25 to 50 m/hr to provide a bed expansion of 10 to 35%.

It is recommended that the backwash procedure be investigated to determine the magnitude and relative durations of the low and high wash rates to provide an adequate backwash and maintain the long-term cleaning of the filter. The study could include the evaluation of the backwash suspended solids at various time intervals during the wash to determine solids removed.

This recommendation could be carried out at any time. The cost of the study would be $10,000 to $15,000.

G.8 High Lift Flow Metering

The high lift instrumentation is checked from the differential pressure onward and is quite reliable. Independent checks of the flow using pitot tubes have shown that some inaccuracies may exist.

It is recommended that a detailed evaluation be conducted to establish the accuracy of the high lift flow metering. The flow from the clearwell must be measured under controlled conditions. A 'clearwell drop test' could verify the high lift flow metering.

This work should be conducted as soon as possible. The cost of the study would be about $10,000.

G.9 Chlorinated By-Products

It is Gore & Storrie's opinion that a broader measurement of chlorinated by-products and other organic contaminants should be considered. Although there is not general agreement in the field which surrogate measurement should be used, the measurement should report the total of all the organic halogen compounds.

G.9 Chlorinated By-Products (cont'd)

It is recommended that the Province of Ontario develop a surrogate measurement for chlorinated by-products and other organic contaminants.

G.10 Treated Water Turbidity

The turbidity guideline in the Province of Ontario is 1.0 FTU, but is is important to reduce the turbidity to as low a level as is practical. The Kingston plant consistently produces water having a turbidity of 0.1 FTU or less; the maximum plant effluent turbidity during the three year period examined was 0.25 FTU. The Kingston Public Utilities Commission believes the low plant effluent turbidity values are a result of appropriate treatment application and good raw water quality. The filter performance has been reviewed, and there is no apparent single factor which is responsible for the excellent effluent water quality. The plant is well operated and several of their routine procedures, such as limiting filter runs to 24 hours and annual filter inspections, all contribute to this excellent treated water quality.

It is recommended that a study be conducted under the research portion of the WPOS program to evaluate how the Kingston plant is able to maintain such low effluent turbidities.

This study could be initiated at any time, but should investigate the various seasonal raw water conditions. The study would cost about $25,000.

APPENDIX A

TABLES

APPENDIX A

TABLES

KINGSTON WTP

MONTH	R/T	1986			1985			1984		
		MAX.	MIN.	AVG.	MAX.	MIN.	AVG.	MAX.	MIN.	AVG.
JAN	R	62.7	54.1	58.1	61.1	48.0	55.1	57.8	49.5	54.0
	T	59.5	50.3	54.8	58.7	42.7	51.6	53.5	45.2	49.7
FEB	R	60.6	53.4	56.2	55.3	49.6	52.4	57.0	44.5	50.8
	T	58.9	50.7	53.5	53.2	45.4	49.2	52.8	41.8	47.1
MAR	R	55.9	54.2	55.0	57.9	48.0	53.7	55.8	47.7	52.3
	T	52.3	49.6	51.2	53.8	47.0	50.2	51.5	43.4	47.1
APR	R	57.7	52.5	54.6	58.4	45.4	50.2	57.0	45.8	51.1
	T	53.5	44.5	49.9	48.6	43.2	46.0	50.5	42.0	47.5
MAY	R	57.1	48.7	53.0	54.3	44.9	49.5	53.0	46.9	50.7
	T	49.8	41.4	46.1	48.6	42.4	45.3	48.0	42.9	46.5
JUN	R	55.4	51.3	53.3	61.7	48.0	53.0	63.7	48.7	55.1
	T	48.1	41.8	46.0	55.8	42.0	46.6	59.7	41.8	50.3
JUL	R	72.5	52.6	59.7	68.0	52.6	60.8	64.4	48.5	55.5
	T	(62.5)	44.6	50.9	62.2	46.5	57.1	(60.4)	44.5	51.5
AUG	R	62.2	50.1	55.9	68.6	48.6	58.5	64.2	45.9	54.5
	T	52.9	41.1	47.1	(64.6)	45.4	54.6	59.2	40.8	49.1
SEP	R	57.9	52.1	54.9	62.2	48.7	55.2	55.5	45.8	52.1
	T	49.6	42.6	47.2	56.9	45.1	50.2	49.9	39.9	45.9
OCT	R	58.3	50.5	54.3	59.7	48.0	54.1	56.9	45.9	52.0
	T	50.6	43.6	48.1	51.4	45.0	48.5	45.6	39.4	43.6
NOV	R	55.0	51.1	53.6	57.5	51.3	53.6	54.4	46.1	50.4
	T	50.3	46.2	48.1	51.8	44.4	48.5	47.1	38.2	43.3
DEC	R	55.0	42.9	51.6	56.6	42.6	53.0	51.3	44.5	48.9
	T	50.0	40.7	46.7	51.1	42.4	48.5	47.5	38.4	44.5

R = Raw; T = Treated

Maximum Raw and Treated water flows for the month do not necessarily occur on the same day.

Brackets indicate maximum day for the year.

TABLE 1.1: PER CAPITA CONSUMPTION (L/D/Capita)

WPOS KINGSTON WTP

CONSUMPTION	1986	1985	1984
Population (1)	80,715	80,715	80,715
Maximum Day	774.3	800.3	748.3
Minimum Day	504.2	520.3	473.3
Average Day	608.7	615.6	584.5
Ratio MD:AD	1.27	1.30	1.28

(1) Population values supplied by the Regional Assessment Office of Kingston. Yearly census not conducted.

MD:AD = Maximum Day/Average Day

TABLE 20 PARTICULATE REMOVAL SUMMARY

MONTH	PARAMETER			1986			1985			1984					
				MAX.	MIN.	AVG.	MAX.	MIN.	AVG.	MAX.	MIN.	AVG.	MAX.	MIN.	AVG.
JAN	Turbidity (FTU)		R	9.0	1.0	1.7	3.0	0.7	1.4	2.0	1.0	1.5			
			T	0.09	0.07	0.08	0.09	0.06	0.07	0.14	0.05	0.08			
	Colour (TCU)		R												
			T												
	Alum	(mg/L)		11.8	6.8	8.9	11.0	7.0	10.9	11.0	7.0	9.6			
	Coagulant Aid	(mg/L)													
	(1)	(mg/L)													
	(2)	(mg/L)													
	(3)	(mg/L)													
	(4)	(mg/L)													
	Metal Res. Al	(mg/L)	R	0.05	0.03	0.05									
			T	0.05	0.02	0.04	0.015		0.015						
	pH		R	8.05	7.9	7.98			8.3						
			T	7.60	7.55	7.58			7.50						
	Temperature	(°C)		0.8	0.4	0.6	2.9	0.3	1.13	0.9	0.3	0.6			
FEB	Turbidity (FTU)		R	1.2	0.7	0.9	2.0	0.7	0.9	2.5	0.7	1.3			
			T	0.25	0.06	0.07	0.08	0.05	0.06	0.15	0.05	0.08			
	Colour (TCU)		R												
			T												
	Alum	(mg/L)		10.9	6.7	8.2	11.8	7.2	9.2	14.3	7.7	9.8			
	Coagulant Aid	(mg/L)													
	(1)	(mg/L)													
	(2)	(mg/L)													
	(3)	(mg/L)													
	(4)	(mg/L)													
	Metal Res. Al	(mg/L)	R	0.03	0.01	0.02									
			T	0.07	0.03	.055	0.05	0.03	0.04						
	pH		R	8.1	7.7	7.94			7.6						
			T	7.59	7.35	7.54			8.0						
	Temperature	(°C)		1.0	0.5	0.8	1.0	0.7	0.84	0.9	0.5	0.8			

R = Raw; T = Treated

Colour values obtained from DWSP chemical analysis result sheets - represents 1 random test for entire month. Aluminum residuals and pH values obtained from the laboratory daily log book at the Kingston plant. The DWSP aluminum results were included with this data. Turbidity and alum values obtained from the monthly Water Condition and Chemicals Used summary sheets. (These turbidity values are taken from the continuously recording turbidity charts).

TABLE 2.0 (cont'd.)

MONTH	PARAMETER			1986			1985			1984					
				MAX.	MIN.	AVG.	MAX.	MIN.	AVG.	MAX.	MIN.	AVG.	MAX.	MIN.	AVG.
MAR	Turbidity (FTU)		R	1.0	0.7	0.84	7.5	0.7	1.02	2.0	0.8	1.1			
			T	0.09	0.06	0.07	0.10	0.07	0.08	0.15	0.05	0.08			
	Colour (TCU)		R												
			T												
	Alum	(mg/L)		11.9	5.0	8.3	14.0	7.3	8.7	12.4	7.5	9.6			
	Coagulant Aid	(mg/L)													
	(1)	(mg/L)													
	(2)	(mg/L)													
	(3)	(mg/L)													
	(4)	(mg/L)													
	Metal Res. Al	(mg/L)	R	0.03	0.02	0.02			*0.01						
			T	0.07	0.03	0.04	0.04	0.02	0.03						
	pH		R	8.05	7.8	7.93	8.1	7.9	8.0						
			T	7.6	7.48	7.56	7.6	7.5	7.55						
	Temperature	(°C)		1.2	0.3	0.58	1.7	0.7	1.01	1.0	0.5	0.64			
APR	Turbidity (FTU)		R	0.90	0.6	0.80	2.0	0.7	1.15	1.5	0.8	1.1			
			T	0.19	0.07	0.09	0.25	0.07	0.11	0.12	0.05	0.07			
	Colour (TCU)		R												
			T												
	Alum	(mg/L)		10.7	6.0	8.3	14.5	7.8	10.1	12.7	7.0	9.6			
	Coagulant Aid	(mg/L)													
	(1)	(mg/L)													
	(2)	(mg/L)													
	(3)	(mg/L)													
	(4)	(mg/L)													
	Metal Res. Al	(mg/L)	R	0.056	0.01	0.03									
			T	0.071	0.03	0.04	0.07	0.03	0.05						
	pH		R	8.19	7.9	8.02	8.3	8.0	8.2						
			T	7.69	7.5	7.59	7.6	7.4	7.56						
	Temperature	(°C)		5.2	1.8	3.4	5.7	1.5	3.18	4.8	1.1	2.8			

R = Raw; T = Treated

* Only one value available for the month.

TABLE 2.0 (cont'd.)

MONTH	PARAMETER			1986			1985			1984					
				MAX.	MIN.	AVG.	MAX.	MIN.	AVG.	MAX.	MIN.	AVG.	MAX.	MIN.	AVG.
MAY	Turbidity (FTU)		R	2.5	0.6	0.87	1.0	0.7	0.9	7.2	0.9	1.4			
			T	0.12	0.07	0.06	0.18	0.07	0.08	0.15	0.06	0.10			
	Colour (TCU)		R												
			T												
	Alum	(mg/L)		11.9	6.4	8.7	14.9	6.9	8.8	13.8	7.2	7.7			
	Coagulant Aid	(mg/L)													
	(1)	(mg/L)													
	(2)	(mg/L)													
	(3)	(mg/L)													
	(4)	(mg/L)													
	Metal Res. Al	(mg/L)	R	0.02	0.01	0.015									
			T	0.15	0.07	0.095	0.1	0.07	0.07						
	pH		R	8.3	8.0	8.17	8.25	7.95	8.15						
			T	7.7	7.5	7.62	7.62	7.5	7.57						
	Temperature	(°C)		8.9	5.8	7.6	8.4	5.2	7.2	9.5	5.2	6.9			
JUN	Turbidity (FTU)		R	1.3	0.70	0.8	1.2	0.7	0.86	1.5	0.8	1.1			
			T	0.09	0.07	0.07	0.08	0.07	0.07	0.18	0.08	0.09			
	Colour (TCU)		R			5									
			T			<1.5									
	Alum	(mg/L)		13.4	4.8	8.7	12.1	7.0	8.3	14.8	7.0	9.9			
	Coagulant Aid	(mg/L)													
	(1)	(mg/L)													
	(2)	(mg/L)													
	(3)	(mg/L)													
	(4)	(mg/L)													
	Metal Res. Al	(mg/L)	R	0.029	0.02	0.025									
			T	0.13	0.07	0.09	0.12	0.04	0.09						
	pH		R	8.15	7.6	7.93	8.2	7.8	7.99						
			T	7.61	7.4	7.50	7.68	7.4	7.53						
	Temperature	(°C)		13.3	7.8	10.1	13.6	8.3	10.8	15	8.5	10			

R = Raw; T = Treated

TABLE 2.0 (cont'd)

MONTH	PARAMETER			1986			1985			1984					
				MAX.	MIN.	AVG.	MAX.	MIN.	AVG.	MAX.	MIN.	AVG.	MAX.	MIN.	AVG.
JUL	Turbidity (FTU)		R	1.0	0.6	0.79	1.8	0.7	0.8	1.2	0.7	0.94			
			T	0.08	0.06	0.07	0.08	0.07	0.07	0.06	0.01	0.07			
	Colour (TCU)		R			2.5			5						
			T			<1			<1						
	Alum	(mg/L)		13.4	6.2	8.7	12.8	6.1	8.5	13.2	7.3	11.0			
	Coagulant Aid	(mg/L)													
	(1)	(mg/L)													
	(2)	(mg/L)													
	(3)	(mg/L)													
	(4)	(mg/L)													
	Metal Res. Al	(mg/L)	R	0.02	0.004	0.01									
			T	0.23	0.06	0.11	0.13	0.05	0.08						
	pH		R	7.65	7.42	7.54	8.28	7.55	7.98						
			T	7.45	7.28	7.34	7.65	7.28	7.44						
	Temperature	(°C)		14.7	9.4	12.2	19.1	11.2	14.7	18.4	9.1	14.5			
AUG	Turbidity (FTU)		R	1.1	0.6	0.83	2.0	0.7	1.1	2.5	0.9	1.3			
			T	0.09	0.06	0.07	0.08	0.07	0.07	0.15	0.07	0.1			
	Colour (TCU)		R			3			5						
			T			<1.5			<1						
	Alum	(mg/L)		14.0	5.0	8.7	12.6	6.1	8.1	15.3	7.4	9.7			
	Coagulant Aid	(mg/L)													
	(1)	(mg/L)													
	(2)	(mg/L)													
	(3)	(mg/L)													
	(4)	(mg/L)													
	Metal Res. Al	(mg/L)	R	0.02	0.015	0.017									
			T	0.15	0.04	0.08	0.11	0.04	0.07						
	pH		R	8.05	7.5	7.70	8.0	7.5	7.78						
			T	7.65	7.25	7.43	7.58	7.20	7.38						
	Temperature	(°C)		20.5	11.4	15.6	20.1	12.1	16.6	19	11	14.6			

R = Raw; T = Treated

TABLE 2.0 (cont'd.)

MONTH	PARAMETER			1986			1985			1984					
				MAX.	MIN.	AVG.	MAX.	MIN.	AVG.	MAX.	MIN.	AVG.	MAX.	MIN.	AVG.
SEP	Turbidity (FTU)		R	2.0	0.6	1.0	1.7	0.8	1.04	1.2	0.8	0.94			
			T	0.08	0.07	0.08	0.08	0.07	0.08	0.17	0.05	0.09			
	Colour (TCU)		R			2.5			<1.5						
			T			<1			<0.5						
	Alum	(mg/L)		12.6	1.7	8.3	13.4	6.0	8.3	15.9	7.0	12.2			
	Coagulant Aid	(mg/L)													
	(1)	(mg/L)													
	(2)	(mg/L)													
	(3)	(mg/L)													
	(4)	(mg/L)													
	Metal Res. Al	(mg/L)	R	0.03	0.005	0.02	0.03	0.015	0.02						
			T	0.14	0.06	0.08	0.13	0.02	0.09						
	pH		R	7.90	7.5	7.70	8.2	7.5	7.87						
			T	7.65	7.3	7.49	7.51	7.2	7.41						
	Temperature	(°C)		17.6	11.5	15.3	18.6	12.5	16.3	20	11	16.9			
OCT	Turbidity (FTU)		R	1.2	0.6	0.83	1.5	0.8	1.0	1.2	0.8	0.97			
			T	0.10	0.07	0.075	0.09	0.08	0.08	0.12	0.06	0.08			
	Colour (TCU)		R			3.5			4						
			T			<1			<0.5						
	Alum	(mg/L)		13.2	5.0	8.9	15.4	8.1	12.6	11.1	6.2	8.2			
	Coagulant Aid	(mg/L)													
	(1)	(mg/L)													
	(2)	(mg/L)													
	(3)	(mg/L)													
	(4)	(mg/L)													
	Metal Res. Al	(mg/L)	R	0.04	0.01	0.03									
			T	0.13	0.04	0.08	0.16	0.06	0.10						
	pH		R	8.40	7.4	7.68	8.25	8.05	8.17						
			T	7.75	7.4	7.58	7.60	7.48	7.54						
	Temperature	(°C)		16.0	11.8	13.4	17.0	12.8	14.8	16.0	13.7	14.5			

R = Raw; T = Treated

MONTH	PARAMETER			1986			1985			1984					
				MAX.	MIN.	AVG.	MAX.	MIN.	AVG.	MAX.	MIN.	AVG.	MAX.	MIN.	AVG.
NOV	Turbidity (FTU)		R	2.0	0.9	0.99	10.0	0.8	1.8	1.7	0.8	1.1			
			T	0.11	0.07	0.08	0.19	0.07	0.09	0.09	0.04	0.07			
	Colour (TCU)		R			<1.5			4.5						
			T			<2.5			<0.5						
	Alum	(mg/L)		12.4	5.0	9.0	12.9	7.0	8.9	16.4	8.0	12.6			
	Coagulant Aid	(mg/L)													
	(1)	(mg/L)													
	(2)	(mg/L)													
	(3)	(mg/L)													
	(4)	(mg/L)													
	Metal Res. Al	(mg/L)	R	0.04	0.02	0.03	0.02	0.01	0.02						
			T	0.13	0.03	0.07	0.08	0.04	0.05						
	pH		R	7.90	7.8	7.84	8.05	7.95	8.05						
			T	7.6	7.5	7.59	7.60	7.40	7.46						
	Temperature	(°C)		11.4	6.5	8.9	12.8	7.0	9.4	13.5	7.7	9.9			
DEC	Turbidity (FTU)		R	7.0	0.8	1.6	5.0	0.7	1.51	7.5	0.9	2.0			
			T	0.18	0.07	0.09	0.20	0.06	0.10	0.08	0.05	0.06			
	Colour (TCU)		R			4			6.5						
			T			<2			<1.5						
	Alum	(mg/L)		12.4	6.0	8.8	11.3	6.9	9.0	15.3	9.0	11.6			
	Coagulant Aid	(mg/L)													
	(1)	(mg/L)													
	(2)	(mg/L)													
	(3)	(mg/L)													
	(4)	(mg/L)													
	Metal Res. Al	(mg/L)	R	0.03	0.01	0.02			*0.02						
			T	0.07	0.03	0.04	0.06	0.02	0.04						
	pH		R	7.9	7.75	7.59	8.0	7.9	7.95						
			T	7.65	7.5	7.57	7.55	7.35	7.48						
	Temperature	(°C)		6.1	2.8	5.2	6.7	0.5	3.7	7.3	2.8	4.9			

R = Raw; T = Treated

* Only one value available for the month.

TABLE 2.1: PARTICULATE REMOVAL PROFILE (JANUARY 1986)

DATE	TURBIDITY (FTU)				COLOUR (TCU)		ALUM	COAG: AID	(1)	(2)	(3)	(4)	METAL RES. Al (mg/L)		pH		TEMP. (°C)
	Raw	Set.	Filter	Treat.	Raw	Treat.	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	
1	1.7			0.08			9.3										0.6
2	1.7			0.08			7.4										0.8
3	9.0			0.08			9.9										0.8
4	2.0			0.08			10.0										0.6
5	2.0			0.08			6.8										0.6
6	1.8			0.09			10.4										0.6
7	1.6			0.08			11.1										0.6
8	1.7			0.09			9.4										0.7
9	1.5			0.07			5.0										0.8
10	1.5			0.07			9.0										0.5
11	1.3			0.07			8.7										0.5
12	1.3			0.07			7.9										0.5
13	1.4			0.07			10.5										0.4
14	1.3			0.07			9.5										0.7
15	1.2			0.08			9.7										0.7

NOTE: Turbidity values and alum doses obtained from "Water Condition and Chemicals Used" monthly summary sheets. Sources of turbidity values: continuous analyzers/chart recorders (hourly readings by operator).

Aluminum residuals and pH taken from laboratory log book. Aluminum analyses by colourimetric method. This method is "a means for estimating aluminum with simpler instrumentation" (Standard Methods, 1985, p. 182) and is not as accurate as atomic absorption methods.

TABLE 2.1 (cont'd.)

DATE	TURBIDITY (FTU)				COLOUR (TCU)		ALUM	COAG. AID	(1)	(2)	(3)	(4)	METAL RES. Al (mg/L)		pH		TEMP. (°C)
	Raw	Set.	Filter	Treat.	Raw	Treat.	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	
16	1.2			0.07			7.5										0.7
17	1.3			0.07			9.0							0.02	7.9	7.55	0.7
18	1.3			0.08			7.6										0.5
19	1.3			0.08			7.0										0.8
20	1.2			0.09			11.8										0.4
21	1.6			0.09			7.3										0.5
22	1.9			0.09			9.5										0.8
23	1.4			0.08			11.3										0.8
24	1.5			0.08			9.3										0.5
25	1.4			0.07			9.1										0.4
26	1.3			0.07			6.8										0.5
27	1.2			0.07			8.6										0.5
28	1.2			0.07			9.9										0.5
29	1.0			0.07			8.6										0.7
30	1.1			0.07			10.0										0.8
31	1.1			0.07			7.8							0.05	8.05	7.60	

TABLE 2.2: PARTICULATE REMOVAL PROFILE (APRIL 1986)

DATE	TURBIDITY (FTU)				COLOUR (TCU)		ALUM	COAG. AID	(1)	(2)	(3)	(4)	METAL RES. Al (mg/L)		pH		TEMP. (°C)
	Raw	Set.	Filter	Treat.	Raw	Treat.	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	
1	1.0			0.09			9.2										1.8
2	0.8			0.10			8.0							0.03	8.0	7.6	2.0
3	0.8			0.08			7.3							0.045	8.0	7.59	2.4
4	0.9			0.08			7.9							0.04	8.0	7.55	2.4
5	0.9			0.08			8.2							0.03	8.0	7.55	2.1
6	0.9			0.08			7.9								8.0	7.6	2.0
7	0.8			0.08			7.0						0.01	0.045*	8.0	7.55	2.1
8	0.8			0.08			9.9								7.91	7.50	2.1
9	0.8			0.08			7.0							0.03	8.05	7.55	2.4
10	0.7			0.07			7.7								8.0	7.65	2.8
11	0.8			0.07			8.3										2.9
12	0.8			0.07			8.3								8.0	7.60	2.9
13	0.8			0.07			10.7							0.06	8.05	7.6	2.9
14	0.7			0.07			8.2										2.7
15	0.7			0.07			8.3										3.0

* DWSP Aluminum results: Raw - 0.056
Treated - 0.071

NOTE: Turbidity values and alum doses obtained from "Water Condition and Chemicals Used" monthly summary sheets. Sources of turbidity values: continuous analyzers/chart recorders (hourly readings by operator).

Aluminum residuals and pH taken from laboratory log book. Aluminum analyses by colourimetric method. This method is "a means for estimating aluminum with simpler instrumentation" (Standard Methods, 1985, p. 182) and is not as accurate as atomic absorption methods.

TABLE 2 2 (cont'd.)

DATE	TURBIDITY (FTU)				COLOUR (TCU)		ALUM	COAG. AID	(1)	(2)	(3)	(4)	METAL RES. Al (mg/L)		pH		TEMP. (°C)
	Raw	Set.	Filter	Treat.	Raw	Treat.	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	
16	0.8			0.09			8.5							0.03	8.05	7.55	3.3
17	0.7			0.09			8.2							0.07	7.9	7.6	3.5
18	0.7			0.08			9.4										3.8
19	0.8			0.08			8.2								8.19	7.69	3.8
20	0.8			0.08			6.0										3.8
21	0.7			0.08			8.0										4.0
22	0.7			0.09			10.2										4.3
23	0.7			0.19			8.7										4.7
24	0.65			0.09			8.5										5.0
25	0.60			0.08			8.2										4.7
26	0.6			0.08			7.0								8.15		4.7
27	0.6			0.08			8.3										4.5
28	0.7			0.08			9.0										4.8
29	0.8			0.19			9.6										5.2
30	0.9			0.14			7.8										4.8
31																	

TABLE 2.3: PARTICULATE REMOVAL PROFILE (JULY 1986)

DATE	TURBIDITY (FTU)				COLOUR (TCU)		ALUM	COAG. AID	(1)	(2)	(3)	(4)	METAL RES. Al (mg/L)		pH		TEMP. (°C)
	Raw	Set.	Filter	Treat.	Raw	Treat.	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	
1	0.70			0.07			8.9										13.3
2	0.70			0.07			6.9										9.8
3	0.85			0.06			10.4										9.4
4	0.85			0.07			8.4										11.2
5	0.80			0.07			7.1										12.1
6	1.0			0.07			8.1										13.1
7	1.0			0.07			9.4										14.0
8	1.0			0.08			10.7										14.3
9	0.7			0.08			10.7										14.5
10	0.7			0.08			10.9										13.2
11	0.8			0.07			7.8										14.7
12	1.0			0.07			6.9										10.7
13	1.0			0.07			6.2										10.8
14	0.9			0.07			8.4										10.2
15	0.8			0.07			7.0										11.1

NOTE: Turbidity values and alum doses obtained from "Water Condition and Chemicals Used" monthly summary sheets. Sources of turbidity values: continuous analyzers/chart recorders (hourly readings by operator).

Aluminum residuals and pH taken from laboratory log book. Aluminum analyses by colourimetric method. This method is "a means for estimating aluminum with simpler instrumentation" (Standard Methods, 1985, p. 182) and is not as accurate as atomic absorption methods.

DATE	TURBIDITY (FTU)				COLOUR (TCU)		ALUM	COAG. AID	(1)	(2)	(3)	(4)	METAL RES. Al (mg/L)		pH		TEMP. (°C)
	Raw	Set.	Filter	Treat.	Raw	Treat.	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	
16	0.8			0.07			9.0										13.7
17	0.8			0.07			6.7										11.9
18	0.8			0.07			8.8										10.9
19	1.0			0.07			9.0										10.9
20	1.0			0.07			7.5								7.50	7.3	10.9
21	0.7			0.07			13.4							0.06	7.42	7.28	11.3
22	0.7			0.07			8.2								7.5	7.31	11.7
23	0.7			0.08			8.0								7.55	7.35	12.8
24	0.6			0.08			7.9								7.6	7.4	14.0
25	0.7			0.08			8.0										14.2
26	0.7			0.07			11.6								7.65	7.45	13.1
27	0.7			0.07			12.2							0.12	7.5	7.3	12.0
28	0.6			0.07			6.9							0.06	7.6	7.35	11.6
29	0.6			0.07			6.0							0.1	7.6	7.3	12.0
30	0.6			0.07			9.3								7.5	7.38	12.7
31	0.9			0.07			9.4										11.8

TABLE 2.4: PARTICULATE REMOVAL PROFILE (OCTOBER 1986)

DATE	TURBIDITY (FTU)				COLOUR (TCU)		ALUM	COAG. AID	(1)	(2)	(3)	(4)	METAL RES. Al (mg/L)		pH		TEMP. (°C)
	Raw	Set.	Filter	Treat.	Raw	Treat.	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	
1	0.7			0.08			13.2								7.9	7.5	15.9
2	0.8			0.08			8.7						0.01	0.04	7.75	7.5	16.0
3	0.8			0.08			6.9									7.5	16.0
4	0.8			0.08			11.7							0.08	7.8	7.6	16.0
5	1.0			0.08			10.5							0.1	7.8	7.55	15.8
6	1.0			0.08			9.4								7.8	7.4	15.5
7	0.7			0.08			8.7								8.4	7.75	14.7
8	0.7			0.09			6.8										14.7
9	0.6			0.07			10.6								7.5	7.5	14.6
10	0.7			0.07			7.9										14.1
11	0.7			0.07			7.9						0.025	0.06	7.6	7.6	13.5
12	0.6			0.07			6.0								7.5	7.61	13.2
13	0.7			0.07			5.8							0.09	7.6	7.61	13.1
14	0.6			0.07			8.6								7.4	7.6	13.0
15	0.6			0.07			10.4								7.5	7.6	13.0

NOTE: Turbidity values and alum doses obtained from "Water Condition and Chemicals Used" monthly summary sheets. Sources of turbidity values: continuous analyzers/chart recorders (hourly readings by operator).

Aluminum residuals and pH taken from laboratory log book. Aluminum analyses by colourimetric method. This method is "a means for estimating aluminum with simpler instrumentation" (Standard Methods, 1985, p. 182) and is not as accurate as atomic absorption methods.

TABLE 2.4 (cont'd.)

DATE	TURBIDITY (FTU)				COLOUR (TCU)		ALUM	COAG. AID	(1)	(2)	(3)	(4)	METAL RES. Al (mg/L)		pH		TEMP. (°C)
	Raw	Set.	Filter	Treat.	Raw	Treat.	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	
16	0.6			0.07			9.8								7.5	7.65	12.9
17	0.7			0.06			7.3										12.8
18	0.7			0.06			7.3										12.8
19	0.7			0.06			7.8										12.5
20	1.0			0.07			9.9										12.3
21	1.0			0.07			5.0										12.2
22	1.0			0.07			8.9										12.2
23	1.2			0.07			12.4										12.2
24	1.2			0.08			12.0							0.11	7.55	7.55	12.1
25	1.0			0.08			6.6								7.51	7.61	12.2
26	1.0			0.08			7.9							0.07	7.4	7.6	12.0
27	1.2			0.10			8.5								7.51	7.65	12.0
28	1.0			0.08			12.4							0.06	7.5	7.6	12.0
29	0.8			0.09			7.6								7.98	7.55	12.0
30	0.8			0.07			10.3							0.04	7.85	7.60	12.1
31	0.7			0.08			10.8								7.90	7.61	11.8

TABLE 2.5: PARTICULATE REMOVAL PROFILE (JANUARY 1985)

DATE	TURBIDITY (FTU)				COLOUR (TCU)		ALUM	COAG. AID	(1)	(2)	(3)	(4)	METAL RES. Al (mg/L)		pH		TEMP. (°C)
	Raw	Set.	Filter	Treat.	Raw	Treat.	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	
1	3.0			0.08			13.1							0.015	8.3	7.5	2.9
2	2.0			0.09			12.2										2.8
3	1.5			0.09			12.1										2.6
4	2.0			0.08			14.7										2.5
5	2.0			0.07			12.8										2.1
6	3.0			0.07			12.4										2.0
7	3.0			0.08			12.4										2.0
8	1.5			0.007			9.9										1.8
9	1.5			0.09			11.3										1.8
10	1.5			0.08			11.6										0.8
11	1.5			0.08			10.5										0.9
12	1.3			0.08			11.6										0.8
13	1.3			0.08			10.7										0.5
14	1.3			0.08			8.4										0.8
15	1.3			0.08			12.3							0.015			0.8

NOTE: Turbidity values and alum doses obtained from "Water Condition and Chemicals Used" monthly summary sheets. Sources of turbidity values: continuous analyzers/chart recorders (hourly readings by operator).

Aluminum residuals and pH taken from laboratory log book. Aluminum analyses by colourimetric method. This method is "a means for estimating aluminum with simpler instrumentation" (Standard Methods, 1985, p. 182) and is not as accurate as atomic absorption methods.

TABLE 2.5 (cont'd.)

DATE	TURBIDITY (FTU)				COLOUR (TCU)		ALUM	COAG. AID	(1)	(2)	(3)	(4)	METAL RES. Al (mg/L)		pH		TEMP. (°C)
	Raw	Set.	Filter	Treat.	Raw	Treat.	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	
16	0.8			0.06			12.2										0.7
17	0.8			0.06			10.7										0.5
18	0.8			0.06			9.7										0.6
19	0.8			0.06			10.5										0.8
20	0.8			0.06			11.7										0.8
21	0.7			0.06			12.1										0.7
22	0.7			0.06			9.9							0.05			0.8
23	0.7			0.07			9.1										0.6
24	0.8			0.06			9.1										0.6
25	0.8			0.07			10.9										0.3
26	0.8			0.07			11.3										0.3
27	1.5			0.07			10.3										0.3
28	1.3			0.07			8.2										0.8
29	1.3			0.06			8.9										0.7
30	1.3			0.06			9.4										0.7
31	1.0			0.06			9.8										0.7

TABLE 2.6: PARTICULATE REMOVAL PROFILE (APRIL 1985)

DATE	TURBIDITY (FTU)				COLOUR (TCU)		ALUM	COAG. AID	(1)	(2)	(3)	(4)	METAL RES. Al (mg/L)		pH		TEMP. (°C)
	Raw	Set.	Filter	Treat.	Raw	Treat.	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	
1	1.0			0.08			10.2										1.5
2	1.0			0.08			9.0										1.7
3	0.8			0.07			7.8										1.7
4	0.8			0.07			9.5										1.8
5	1.0			0.08			9.8										1.9
6	1.5			0.08			10.8										2.0
7	2.0			0.07			10.8										2.1
8	1.5			0.08			8.1										2.2
9	1.2			0.09			11.6										2.5
10	1.2			0.10			9.9							0.07	8.0	7.6	2.5
11	1.0			0.10			11.2										2.8
12	1.5			0.15			10.9										2.8
13	2.0			0.25			10.6										2.7
14	1.5			0.20			8.2										2.8
15	1.2			0.18			6.3										2.9

NOTE: Turbidity values and alum doses obtained from "Water Condition and Chemicals Used" monthly summary sheets. Sources of turbidity values: continuous analyzers/chart recorders (hourly readings by operator).

Aluminum residuals and pH taken from laboratory log book. Aluminum analyses by colourimetric method. This method is "a means for estimating aluminum with simpler instrumentation" (Standard Methods, 1985, p. 182) and is not as accurate as atomic absorption methods.

TABLE 2.6 (cont'd.)

DATE	TURBIDITY (FTU)				COLOUR (TCU)		ALUM	COAG. AID	(1)	(2)	(3)	(4)	METAL RES. Al (mg/L)		pH		TEMP. (°C)
	Raw	Set.	Filter	Treat.	Raw	Treat.	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	
16	1.0			0.18			9.7										3.0
17	1.4			0.20			12.5										3.6
18	1.5			0.25			10.0										3.5
19	1.2			0.15			11.7										3.2
20	1.2			0.12			11.6										3.2
21	1.2			0.10			10.0								8.2	7.4	3.4
22	1.0			0.08			8.5							0.07			3.9
23	1.0			0.09			13.0							0.045			4.1
24	0.9			0.08			9.8								8.2	7.6	4.1
25	0.9			0.08			9.3							0.055			4.8
26	0.9			0.08			14.5										4.8
27	0.8			0.07			9.5							0.05	8.3	7.6	4.7
28	0.8			0.07			9.5										4.6
29	0.8			0.07			11.2										5.0
30	0.7			0.07			8.9							0.03	8.3	7.6	5.7
31																	

TABLE 2.7: PARTICULATE REMOVAL PROFILE (JULY 1985)

DATE	TURBIDITY (FTU)				COLOUR (TCU)		ALUM	COAG. AID	(1)	(2)	(3)	(4)	METAL RES. Al (mg/L)		pH		TEMP. (°C)
	Raw	Set.	Filter	Treat.	Raw	Treat.	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	
1	0.8			0.07			7.1										11.2
2	0.8			0.07			7.9								7.9	7.5	11.9
3	0.7			0.07			7.3							0.08	7.95	7.45	12.3
4	0.7			0.07			9.1										13.0
5	0.7			0.07			9.0							0.08	8.2	7.60	13.5
6	0.7			0.07			8.2							0.05	8.1	7.51	13.5
7	0.7			0.07			8.4										13.5
8	0.8			0.07			7.0							0.07	7.9	7.5	13.5
9	0.8			0.07			6.8							0.07	8.2	7.45	14.1
10	0.8			0.07			7.7								8.0	7.55	13.4
11	0.7			0.07			10.9										14.0
12	0.7			0.07			9.5										16.2
13	0.8			0.07			8.6							0.07	7.55	7.30	12.0
14	0.8			0.07			6.1								7.6	7.28	12.5
15	0.7			0.07			6.5								8.28	7.4	16.5

NOTE: Turbidity values and alum doses obtained from "Water Condition and Chemicals Used" monthly summary sheets. Sources of turbidity values: continuous analyzers/chart recorders (hourly readings by operator).

Aluminum residuals and pH taken from laboratory log book. Aluminum analyses by colourimetric method. This method is "a means for estimating aluminum with simpler instrumentation" (Standard Methods, 1985, p. 182) and is not as accurate as atomic absorption methods.

TABLE 2.7 (cont'd.)

DATE	TURBIDITY (FTU)				COLOUR (TCU)		ALUM	COAG. AIO	(1)	(2)	(3)	(4)	METAL RES. Al (mg/L)		pH		TEMP. (°C)
	Raw	Set.	Filter	Treat.	Raw	Treat.	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	
16	0.8			0.07			11.8							0.13	8.28	7.65	17.0
17	0.8			0.07			8.5							0.07	8.0	7.3	14.0
18	0.8			0.07			7.2							0.06	7.75	7.28	12.6
19	0.8			0.07			5.0										12.3
20	0.8			0.08			3.7										15.4
21	0.8			0.08			19.7										17.4
22	0.7			0.08			12.8										17.3
23	0.7			0.08			9.0										18.4
24	0.7			0.08			5.3										18.5
25	0.7			0.08			5.0										18.9
26	0.8			0.08			11.7										19.1
27	0.9			0.08			5.2										17.5
28	1.0			0.08			16.7										12.3
29	1.8			0.07			7.0										14.4
30	1.3			0.07			10.0										18.7
31	1.2			0.07			7.3										12.9

TABLE 2.8: PARTICULATE REMOVAL PROFILE (OCTOBER 1985)

DATE	TURBIDITY (FTU)				COLOUR (TCU)		ALUM	COAG. AID	(1)	(2)	(3)	(4)	METAL RES. Al (mg/L)		pH		TEMP. (°C)
	Raw	Set.	Filter	Treat.	Raw	Treat.	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	
1	1.0			0.08			10.7							0.13	8.2	7.55	17.0
2	1.0			0.08			10.7							0.13	8.25	7.6	17.0
3	0.8			0.09			8.5							0.14	8.21	7.55	16.9
4	0.9			0.09			6.2							0.16	8.2	7.6	16.2
5	1.0			0.09			7.0										15.4
6	1.5			0.09			11.1										16.0
7	1.3			0.08			10.2						0.025	0.08*	8.15	7.6	15.9
8	1.0			0.08			6.6							0.11	8.2	7.5	15.9
9	1.0			0.08			3.5							0.095	8.19	7.5	15.8
10	1.0			0.08			8.1							0.10	8.12	7.55	15.8
11	1.0			0.08			11.7							0.09	8.25	7.60	15.6
12	1.2			0.08			6.2										15.3
13	1.0			0.08			5.3										15.0
14	1.0			0.08			6.3										15.0
15	1.0			0.08			9.5										14.9

* DWSP Aluminum results: Raw - 0.033
Treated - 0.100

NOTE: Turbidity values and alum doses obtained from "Water Condition and Chemicals Used" monthly summary sheets. Sources of turbidity values: continuous analyzers/chart recorders (hourly readings by operator).

Aluminum residuals and pH taken from laboratory log book. Aluminum analyses by colourimetric method. This method is "a means for estimating aluminum with simpler instrumentation" (Standard Methods, 1985, p. 182) and is not as accurate as atomic absorption methods.

TABLE 2.8 (cont'd.)

DATE	TURBIDITY (FTU)				COLOUR (TCU)		ALUM	COAG. AID	(1)	(2)	(3)	(4)	METAL RES. Al (mg/L)		pH		TEMP. (°C)
	Raw	Set.	Filter	Treat.	Raw	Treat.	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	
16	1.0			0.08			11.7							0.11	8.05	7.55	14.9
17	0.8			0.08			8.4							0.1	8.1	7.5	14.7
18	0.8			0.08			6.1							0.13			14.4
19	0.8			0.08			7.2							0.095	8.11	7.55	14.2
20	1.0			0.08			10.8							0.09	8.15	7.5	14.2
21	1.0			0.08			9.7										14.1
22	1.0			0.08			7.0							0.10	8.2	7.6	14.0
23	1.2			0.08			8.6							0.09	8.12	7.5	13.9
24	1.2			0.08			5.0										13.8
25	1.2			0.08			9.8										13.8
26	0.8			0.08			9.4							0.095	8.23	7.50	13.8
27	0.8			0.08			8.5							0.07			13.8
28	0.9			0.08			8.6							0.11	8.1	7.55	13.5
29	1.3			0.08			7.3							0.06			13.0
30	1.3			0.08			7.1							0.055			12.8
31	1.3			0.08			8.4								8.15	7.48	12.8

TABLE 2.9: PARTICULATE REMOVAL PROFILE (JANUARY 1984)

DATE	TURBIDITY (FTU)				COLOUR (TCU)		ALUM	COAG. AID	(1)	(2)	(3)	(4)	METAL RES. Al (mg/L)		pH		TEMP. (°C)
	Raw	Set.	Filter	Treat.	Raw	Treat.	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	
1	1.5			0.07			9.1										0.5
2	1.5			0.07			9.0										0.6
3	1.5			0.07			8.6										0.5
4	2.0			0.07			8.3										0.5
5	2.0			0.06			8.1										0.5
6	1.4			0.06			9.2										0.3
7	1.5			0.06			11.1										0.3
8	1.5			0.06			10.6										0.3
9	1.3			0.06			10.3										0.5
10	1.3			0.06			9.5										0.5
11	1.8			0.06			11.2										0.6
12	1.8			0.07			9.4										0.8
13	1.8			0.07			8.7										0.8
14	1.8			0.07			9.7										0.8
15	1.5			0.07			10.4										0.8

NOTE: Turbidity values and alum doses obtained from "Water Condition and Chemicals Used" monthly summary sheets. Sources of turbidity values: continuous analyzers/chart recorders (hourly readings by operator).

Aluminum residuals and pH taken from laboratory log book. Aluminum analyses by colourimetric method. This method is "a means for estimating aluminum with simpler instrumentation" (Standard Methods, 1985, p. 182) and is not as accurate as atomic absorption methods.

TABLE 2.9 (cont'd.)

DATE	TURBIDITY (FTU)				COLOUR (TCU)		ALUM	COAG. AID	(1)	(2)	(3)	(4)	METAL RES. Al (mg/L)		pH		TEMP. (°C)
	Raw	Set.	Filter	Treat.	Raw	Treat.	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	
16	1.5			0.14			10.3										0.8
17	1.8			0.08			10.8										0.7
18	1.8			0.13			9.1										0.7
19	2.0			0.13			11.0										0.7
20	1.5			0.13			10.6										0.7
21	1.8			0.13			10.0										0.5
22	1.0			0.13			9.6										0.4
23	1.0			0.06			8.7										0.4
24	1.0			0.06			7.0										0.5
25	1.0			0.06			8.8										0.8
26	1.0			0.06			10.3										0.9
27	1.0			0.06			9.3										0.9
28	1.0			0.06			9.9										0.8
29	1.0			0.06			9.9										0.5
30	1.0			0.05			8.5										0.5
31	1.0			0.05			10.3										0.5

TABLE 2.10: PARTICULATE REMOVAL PROFILE (APRIL 1984)

DATE	TURBIDITY (FTU)				COLOUR (TCU)		ALUM	COAG. AID	(1)	(2)	(3)	(4)	METAL RES. Al (mg/L)		pH		TEMP. (°C)
	Raw	Set.	Filter	Treat.	Raw	Treat.	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	
1	1.0			0.07			11.2										1.1
2	0.9			0.07			9.7										1.3
3	1.0			0.07			9.7										1.5
4	0.8			0.05			9.3										1.6
5	1.5			0.06			7.5										1.9
6	1.5			0.06			7.6										1.9
7	1.0			0.06			12.3										1.8
8	1.0			0.06			12.7										1.8
9	1.0			0.06			10.1										1.9
10	1.0			0.06			9.3										1.9
11	0.9			0.07			8.1										2.1
12	1.0			0.07			7.3										2.8
13	1.0			0.07			9.7										2.9
14	1.0			0.07			9.6										2.6
15	1.0			0.07			9.2										2.9

NOTE: Turbidity values and alum doses obtained from "Water Condition and Chemicals Used" monthly summary sheets. Sources of turbidity values: continuous analyzers/chart recorders (hourly readings by operator).

Aluminum residuals and pH taken from laboratory log book. Aluminum analyses by colourimetric method. This method is "a means for estimating aluminum with simpler instrumentation" (Standard Methods, 1985, p. 182) and is not as accurate as atomic absorption methods.

TABLE 2.10 (cont'd.)

DATE	TURBIDITY (FTU)				COLOUR (TCU)		ALUM	COAG. AID	(1)	(2)	(3)	(4)	METAL RES. Al (mg/L)		pH		TEMP. (°C)
	Raw	Set.	Filter	Treat.	Raw	Treat.	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	
16	1.0			0.07			9.2										3.0
17	1.0			0.08			9.5										3.0
18	1.0			0.09			9.4										3.0
19	1.0			0.08			9.7										3.0
20	1.0			0.08			8.9										3.1
21	1.0			0.08			11.8										3.4
22	1.5			0.08			11.2										3.6
23	1.5			0.08			7.0										3.8
24	1.0			0.12			6.3										3.8
25	1.0			0.07			9.0										3.9
26	1.2			0.07			10.2										3.9
27	1.0			0.07			12.4										4.0
28	1.0			0.07			9.0										4.2
29	1.0			0.07			11.4										4.4
30	1.2			0.06			9.5										4.8
31																	

TABLE 2.11: PARTICULATE REMOVAL PROFILE (JULY 1984)

DATE	TURBIDITY (FTU)				COLOUR (TCU)		ALUM	COAG. AID	(1)	(2)	(3)	(4)	METAL RES. Al (mg/L)		pH		TEMP. (°C)
	Raw	Set.	Filter	Treat.	Raw	Treat.	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	
1	0.9			0.07			14.7										9.1
2	0.9			0.07			7.3										10.2
3	0.8			0.07			9.0										12.8
4	0.8			0.07			11.0										13.0
5	0.7			0.06			10.2										13.8
6	0.7			0.06			11.4										13.1
7	1.0			0.06			19.5										13.5
8	1.0			0.06			13.2										14.8
9	1.0			0.07			8.8										15.1
10	0.9			0.08			12.1										13.6
11	0.9			0.08			10.3										10.8
12	0.7			0.06			10.5										13.3
13	0.8			0.07			10.3										15.8
14	1.0			0.07			15.7										16.9
15	1.0			0.07			10.6										17.1

NOTE: Turbidity values and alum doses obtained from "Water Condition and Chemicals Used" monthly summary sheets. Sources of turbidity values: continuous analyzers/chart recorders (hourly readings by operator).

Aluminum residuals and pH taken from laboratory log book. Aluminum analyses by colourimetric method. This method is "a means for estimating aluminum with simpler instrumentation" (Standard Methods, 1985, p. 182) and is not as accurate as atomic absorption methods.

TABLE 2.11 (cont'd.)

DATE	TURBIDITY (FTU)				COLOUR (TCU)		ALUM	COAG. AID	(1)	(2)	(3)	(4)	METAL RES. Al (mg/L)		pH		TEMP. (°C)
	Raw	Set.	Filter	Treat.	Raw	Treat.	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	
16	0.9			0.07			12.2										17.4
17	0.9			0.07			9.6										17.6
18	0.9			0.07			10.2										16.4
19	0.9			0.07			10.3										16.5
20	0.9			0.08			13.2										18.4
21	0.9			0.08			11.6										18.4
22	1.0			0.08			11.9										11.5
23	1.0			0.08			11.3										11.4
24	1.0			0.06			15.5										15.1
25	1.2			0.09			11.1										16.6
26	1.2			0.09			6.8										16.9
27	1.2			0.09			8.7										13.0
28	1.0			0.09			7.8										11.30
29	1.0			0.09			7.9										13.1
30	0.9			0.09			10.0										15.8
31	1.2			0.10			9.2										17

TABLE 2.12: PARTICULATE REMOVAL PROFILE (OCTOBER 1984)

DATE	TURBIDITY (FTU)				COLOUR (TCU)		ALUM	COAG. AID	(1)	(2)	(3)	(4)	METAL RES. Al (mg/L)		pH		TEMP. (°C)
	Raw	Set.	Filter	Treat.	Raw	Treat.	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	
1	1.0			0.07			9.7										14.5
2	0.8			0.06			12.0										14.0
3	0.9			0.08			9.7										16.0
4	1.2			0.12			13.9										15.8
5	1.2			0.08			13.9										15.8
6	1.0			0.08			11.2										15.0
7	0.9			0.08			8.9										15.0
8	0.8			0.08			8.1										15.0
9	0.8			0.07			12.5										15.0
10	0.8			0.07			11.9										15.0
11	0.8			0.08			12.1										15.0
12	1.0			0.08			11.2										14.9
13	1.0			0.08			13.6										14.3
14	1.0			0.09			12.7										14.1
15	1.2			0.12			12.8										14.5

NOTE: Turbidity values and alum doses obtained from "Water Condition and Chemicals Used" monthly summary sheets. Sources of turbidity values: continuous analyzers/chart recorders (hourly readings by operator).

Aluminum residuals and pH taken from laboratory log book. Aluminum analyses by colourimetric method. This method is "a means for estimating aluminum with simpler instrumentation" (Standard Methods, 1985, p. 182) and is not as accurate as atomic absorption methods.

TABLE 2.12 (cont'd.)

DATE	TURBIDITY (FTU)				COLOUR (TCU)		ALUM	COAG. AID	(1)	(2)	(3)	(4)	METAL RES. Al (mg/L)		pH		TEMP. (°C)
	Raw	Set.	Filter	Treat.	Raw	Treat.	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Raw	Treat.	Raw	Treat.	
16	0.8			0.08			15.1										14.6
17	0.8			0.09			13.8										14.7
18	0.8			0.09			13.0										14.7
19	1.0			0.10			9.2										14.1
20	1.2			0.10			15.2										14.2
21	1.2			0.10			10.3										14.2
22	0.8			0.08			15.5										14.3
23	1.0			0.08			15.6										14.5
24	1.0			0.08			13.1										14.5
25	1.0			0.08			12.2										14.2
26	1.0			0.08			11.9										14.1
27	1.0			0.07			9.2										13.8
28	1.0			0.07			15.2										13.7
29	1.0			0.07			18.0										13.8
30	1.0			0.07			12.6										13.8
31	1.0			0.07			15.4										13.9

TABLE 3.0: DISINFECTION SUMMARY

MONTH	CHEMICAL	1986						1985						1984					
		PRE-			POST-			PRE-			POST-			PRE-			POST-		
		Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.
JAN	Cl_2 Demand																		
	Cl_2 Dosage	1.2	1.0	1.1				1.6	1.2	1.3				1.5	1.2	1.3			
	NH_3																		
	SO_2				0.17	0.06	0.11				0.30	0.14	0.21				0.32	0.14	0.22
	Cl_2 Res. (Free)	0.70	0.35					0.75	0.40					0.70	0.38				
	Cl_2 Res. (Comb.)																		
	Cl_2 Res. (Total)				0.60	0.30					0.64	0.32					0.58	0.32	
	F- Dosage																		
	F- Res.						0.12												
FEB	Cl_2 Demand																		
	Cl_2 Dosage	1.8	1.1	1.3				1.5	1.2	1.3				1.8	1.2	1.4			
	NH_3																		
	SO_2										0.25	0.14	0.21				0.37	0.12	0.24
	Cl_2 Res. (Free)	0.70	0.35					0.75	0.40					0.82	0.37				
	Cl_2 Res. (Comb.)																		
	Cl_2 Res. (Total)				0.60	0.31					0.59	0.32					0.62	0.30	
	F- Dosage																		
	F- Res.						0.14												
MAR	Cl_2 Demand																		
	Cl_2 Dosage	1.2	0.3	0.6				1.6	1.1	1.2				1.8	1.2	1.4			
	NH_3																		
	SO_2				0.23	0.09	0.12				0.28	0.14	0.20				0.38	0.16	0.26
	Cl_2 Res. (Free)	0.65	0.30		0.53	0.34	0.43	0.70	0.35					0.75	0.35				
	Cl_2 Res. (Comb.)				0.16	0.11	0.14												
	Cl_2 Res. (Total)				0.65	0.42	0.51				0.55	0.28					0.60	0.30	
	F- Dosage																		
	F- Res.						0.14												

Maximum and minimum free, combined, and total chlorine residuals do not necessarily occur on the same day. Tabulated maximum and minimum pre and post chlorine residuals were taken from the monthly Water Plant Data sheets; these residuals were obtained from the continuous chlorine analyzer sheets. From March 1988 onward, post chlorine residuals of grab samples (free and combined) were measured in the lab, and these values have been reported.

Chlorine and SO_2 dosages were taken from the monthly Water Condition and Chemicals Used summary sheets. Fluoride residuals were obtained from the DWSP chemical analysis results sheet - represents one random test for entire month.

TABLE 3.0 (cont'd.)

MONTH	CHEMICAL	1986						1985						1984					
		PRE-			POST-			PRE-			POST-			PRE-			POST-		
		Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.
APR	Cl_2 Demand																		
	Cl_2 Dosage	1.7	1.2	1.4				2.0	1.5	1.7				1.8	1.4	1.6			
	NH_3																		
	SO_2										0.34	0.14	0.21				0.41	0.12	0.23
	Cl_2 Res. (Free)	0.75	0.30					0.78	0.36					0.75	0.30				
	Cl_2 Res. (Comb.)				0.16	0.13	0.15												
	Cl_2 Res. (Total)										0.65	0.30					0.62	0.30	
	F- Dosage																		
	F- Res.						0.14												
MAY	Cl_2 Demand																		
	Cl_2 Dosage	1.9	1.4	1.6				2.1	1.5	1.8				2.2	1.5	1.7			
	NH_3																		
	SO_2										0.38	0.08	0.21				0.43	0.06	0.19
	Cl_2 Res. (Free)	0.73	0.38					0.75	0.40					0.80	0.45				
	Cl_2 Res. (Comb.)				0.14	0.12	0.13												
	Cl_2 Res. (Total)										0.60	0.31					0.63	0.32	
	F- Dosage																		
	F- Res.						0.10												
JUN	Cl_2 Demand																		
	Cl_2 Dosage	1.8	1.5	1.6				2.0	1.6	1.8				2.1	1.6	1.8			
	NH_3																		
	SO_2				0.27	0.12	0.18				0.37	0.14	0.22				0.42	0.08	0.22
	Cl_2 Res. (Free)	0.70	0.35		0.51	0.25	0.30	0.80	0.38					0.75	0.38				
	Cl_2 Res. (Comb.)				0.19	0.13	0.15												
	Cl_2 Res. (Total)				0.55	0.40	0.44				0.59	0.30					0.60	0.38	
	F- Dosage																		
	F- Res.						0.13												

Maximum and minimum free, combined, and total chlorine residuals do not necessarily occur on the same day. Tabulated maximum and minimum pre and post chlorine residuals were taken from the monthly Water Plant Data sheets; these residuals were obtained from the continuous chlorine analyzer sheets. From March 1988 onward, post chlorine residuals of grab samples (free and combined) were measured in the lab, and these values have been reported.

Chlorine and SO_2 dosages were taken from the monthly Water Condition and Chemicals Used summary sheets. Fluoride residuals were obtained from the DWSP chemical analysis results sheet - represents one random test for entire month.

TABLE 3.0 (cont'd.)

MONTH	CHEMICAL	1986						1985						1984					
		PRE-			POST-			PRE-			POST-			PRE-			POST-		
		Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.
JUL	Cl_2 Demand																		
	Cl_2 Dosage	1.7	1.4	1.6				2.0	1.7	1.8				2.2	2.0	2.1			
	NH_3																		
	SO_2										0.33	0.10	.018				0.34	0.13	0.23
	Cl_2 Res. (Free)	0.77	0.35		0.44	0.22	0.30	0.70	0.40					0.80	0.45				
	Cl_2 Res. (Comb.)				0.18	0.15	0.16												
	Cl_2 Res. (Total)				0.59	0.37	0.46				0.60	0.30					0.60	0.40	
	F- Dosage																		
	F- Res.						0.14						0.11						
AUG	Cl_2 Demand																		
	Cl_2 Dosage	1.9	1.3	1.6				2.0	1.5	1.7				2.2	1.5	1.8			
	NH_3																		
	SO_2				0.29	0.06	0.14				0.41	0.14	0.2				0.28	0.12	0.21
	Cl_2 Res. (Free)	0.72	0.36		0.39	0.15	0.3	0.80	0.40					0.75	0.35				
	Cl_2 Res. (Comb.)				0.19	0.13	0.17												
	Cl_2 Res. (Total)				0.58	0.31	0.47				0.64	0.31					0.63	0.34	
	F- Dosage																		
	F- Res.						0.15						0.12						
SEP	Cl_2 Demand																		
	Cl_2 Dosage	1.8	1.4	1.7				2.0	1.6	1.8				2.3	1.5	1.9			
	NH_3																		
	SO_2				0.17	0.06	0.10				0.33	0.08	0.23				0.34	0.12	0.25
	Cl_2 Res. (Free)	0.70	0.30		0.46	0.24	0.37	0.75	0.35					0.80	0.38				
	Cl_2 Res. (Comb.)				0.19	0.15	0.17												
	Cl_2 Res. (Total)				0.62	0.39	0.53				0.62	0.30					0.63	0.31	
	F- Dosage																		
	F- Res.						0.12						0.12						

Maximum and minimum free, combined, and total chlorine residuals do not necessarily occur on the same day. Tabulated maximum and minimum pre and post chlorine residuals were taken from the monthly Water Plant Data sheets; these residuals were obtained from the continuous chlorine analyzer sheets. From March 1988 onward, post chlorine residuals of grab samples (free and combined) were measured in the lab, and these values have been reported.

Chlorine and SO_2 dosages were taken from the monthly Water Condition and Chemicals Used summary sheets. Fluoride residuals were obtained from the DWSP chemical analysis results sheet - represents one random test for entire month.

MONTH	CHEMICAL	1986						1985						1984					
		PRE-			POST-			PRE-			POST-			PRE-			POST-		
		Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.
OCT	Cl_2 Demand																		
	Cl_2 Dosage	1.8	1.5	1.6				1.9	1.5	1.7				1.8	1.6	1.7			
	NH_3																		
	SO_2				0.18	0.06	0.12				0.33	0.14	0.22				0.35	0.12	0.24
	Cl_2 Res. (Free)	0.75	0.35		0.44	0.26	0.34	0.75	0.30					0.73	0.31				
	Cl_2 Res. (Comb.)				0.20	0.14	0.17												
	Cl_2 Res. (Total)				0.62	0.40	0.51				0.62	0.31					0.59	0.31	
	F- Dosage																		
	F- Res.						0.15						0.14						
NOV	Cl_2 Demand																		
	Cl_2 Dosage	1.6	1.4	1.5				1.9	1.4	1.7				1.6	1.3	1.48			
	NH_3																		
	SO_2				0.12	0.06	0.09				0.29	0.11	0.20				0.32	0.16	0.25
	Cl_2 Res. (Free)	0.76	0.35		0.45	0.29	0.37	0.75	0.40					0.72	0.40				
	Cl_2 Res. (Comb.)				0.18	0.14	0.16												
	Cl_2 Res. (Total)				0.60	0.46	0.53				0.60	0.35					0.57	0.30	
	F- Dosage																		
	F- Res.						0.15						0.12						
DEC	Cl_2 Demand																		
	Cl_2 Dosage	1.6	1.4	1.2				1.4	1.1	1.25				1.5	1.3	1.36			
	NH_3																		
	SO_2				0.19	0.08	0.12				0.25	0.09	0.12				0.28	0.16	0.21
	Cl_2 Res. (Free)	0.75	0.35		0.44	0.29	0.37	0.70	0.30					0.75	0.35				
	Cl_2 Res. (Comb.)				0.61	0.12	0.17												
	Cl_2 Res. (Total)				0.58	0.17	0.48				0.64	0.30					0.62	0.46	
	F- Dosage																		
	F- Res.						0.13						0.12						

Maximum and minimum free, combined, and total chlorine residuals do not necessarily occur on the same day. Tabulated maximum and minimum pre and post chlorine residuals were taken from the monthly Water Plant Data sheets; these residuals were obtained from the continuous chlorine analyzer sheets. From March 1988 onward, post chlorine residuals of grab samples (free and combined) were measured in the lab, and these values have been reported.

Chlorine and SO_2 dosages were taken from the monthly Water Condition and Chemicals Used summary sheets. Fluoride residuals were obtained from the DWSP chemical analysis results sheet - represents one random test for entire month.

TABLE 3.1: DISINFECTION PROFILE (JAN/1986)

DATE	PRE-CHLORINATION							POST-CHLORINATION							FLUORIDE	
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Dos.	Res.
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total		
1		1.1			.38-.44						0.08			.3-.45		
2		1.0			.37-.47						0.08			.33-.47		
3		1.1			.38-.46						0.06			.34-.45		
4		1.2			.40-.54						0.07			.36-.60		
5		1.1			.35-.50						0.06			.31-.45		
6		1.2			.35-.51						0.06			.37-.54		0.12
7		1.2			.39-.58						0.05			.46-.62		
8		1.1			.35-.49						0.09			.36-.57		
9		1.1			.36-.57						0.09			.39-.54		
10		1.1			.43-.49						0.09			.42-.55		
11		1.1			.35-.53						0.11			.31-.58		
12		1.1			.43-.48						0.09			.35-.48		
13		1.1			.50-.70						0.11			.31-.58		
14		1.1			.38-.55						0.13			.31-.58		
15		1.1			.34-.49						0.10			.30-.53		
16		1.1			.45-.47						0.12			.34-.61		
17		1.1			.44-.54						0.11			.30-.47		
18		1.2			.36-.50						0.10			.32-.50		
19		1.2			.50-.52						0.09			.26-.46		
20		1.2			.49-.68						0.09			.45-.62		
21		1.2			.43-.54						0.17			.35-.54		
22		1.2			.48-.70						0.12			.41-.59		
23		1.2			.53-.65						0.20			.34-.57		
24		1.2			.35-.55						0.13			.34-.58		
25		1.2			.42-.61						0.13			.42-.53		
26		1.2			.45-.58						0.13			.40-.60		
27		1.0			.35-.47						0.12			.31-.57		
28		1.1			.38-.53						0.10			.34-.54		
29		1.1			.35-.62						0.13			.37-.60		
30		1.1			.41-.56						0.17			.31-.62		
31		1.1			.40-.58						0.11			.36-.57		

Free pre-chlorine residual high and low values taken from the Cl_2 analyzer charts. Fluoride residuals obtained from OWSP chemical analysis sheet. Total post-chlorine residual high and low values taken from Kingston WTP monthly chemical usage summary sheets. Chlorine and sulphur dioxide doses taken from "Water Condition and Chemicals Used" monthly summary.

TABLE 3.2: DISINFECTION PROFILE (APR/1986)

DATE	PRE-CHLORINATION							POST-CHLORINATION							FLUORIDE	
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2				
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total	Dos.	Res.
1		1.3			.36-.50						0.12			.31-.45		
2		1.4			.42-.54						0.10		0.15	.34-.54		
3		1.3			.40-.54						0.12		0.16	.38-.59		
4		1.4			.42-.63						0.14		0.15	.41-.57		
5		1.3			.45-.53						0.14		0.14	.40-.54		
6		1.3			.51-.56						0.14		0.15	.37-.55		
7		1.3			.41-.49						0.15		0.13	.39-.45		0.14
8		1.3			.44-.66						0.17			.30-.56		
9		1.4			.41-.62						0.24		0.13	.33-.61		
10		1.3			.35-.52						0.19			.34-.49		
11		1.3			.37-.48						0.10			.37-.50		
12		1.2			.39-.47						0.10		0.14	.39-.49		
13		1.3			.41-.54						0.11		0.16	.41-.54		
14		1.2			.37-.51						0.10		0.14	.44-.54		
15		1.3			.40-.50						0.10		0.15	.38-.56		
16		1.4			.32-.50						0.10		0.14	.40-.50		
17		1.6			.32-.64						0.10		0.16	.39-.59		
18		1.4			.33-.50						0.23			.33-.56		
19		1.7			.31-.52						0.11		0.14	.40-.59		
20		1.6			.37-.64						0.14			.30-.63		
21		1.6			.48-.56						0.10			.39-.63		
22		1.5			.39-.75						0.10			.32-.61		
23		1.4			.41-.55						0.10			.43-.55		
24		1.5			.35-.49						0.09			.35-.53		
25		1.7			.30-.68						0.18			.32-.64		
26		1.4			.42-.67						0.29			.35-.56		
27		1.4			.36-.46						0.17			.31-.42		
28		1.5			.36-.55						0.12			.33-.56		
29		1.6			.30-.60						0.12			.35-.52		
30		1.5			.33-.56						0.12			.32-.51		
31																

Fluoride residuals obtained form DWSP chemical analysis sheet. Free pre-chlorine residual high and low values taken from the Cl_2 analyzer charts. Total post chlorine residual high and low values taken from Kingston WTP monthly chemical usage summary sheets. Free, combined, and total post chlorine residuals taken from the laboratory daily log book. Chlorine and sulphur dioxide doses taken from "Water Condition and Chemicals Used" monthly summary.

TABLE 3.3: DISINFECTION PROFILE (JUL/1986)

DATE	PRE-CHLORINATION							POST-CHLORINATION							FLUORIDE	
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Dos.	Res.
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total		
1		1.6			.39-.52						0.12			.37-.48		
2		1.7			.37-.48						0.12			.42-.47		
3		1.7			.38-.46						0.12			.42-.49		
4		1.7			.38-.60						0.12			.40-.55		
5		1.6			.35-.48						0.12			.24-.41		
6		1.6			.35-.56						0.11			.30-.59		
7		1.6			.39-.63						0.10			.34-.64		0.14
8		1.5			.38-.50						0.12			.41-.62		
9		1.5			.34-.62						0.09			.31-.55		
10		1.6			.33-.65						0.11			.32-.59		
11		1.6			.35-.56						0.10			.39-.51		
12		1.6			.36-.50						0.13			.36-.50		
13		1.6			.42-.47						0.13			.35-.48		
14		1.6			.44-.53						0.13			.36-.58		
15		1.5			.43-.50						0.11			.40-.52		
16		1.6			.41-.48						0.11			.36-.46		
17		1.7			.35-.53						0.12			.33-.55		
18		1.7			.39-.61						0.23	0.22	0.15	0.37		
19		1.6			.55-.63						0.24	0.24	0.17	0.41		
20		1.5			.44-.56						0.22	0.26	0.17	0.43		
21		1.5			.46-.52						0.18			.35-.56		
22		1.6			.36-.77						0.13	0.31	0.17	0.48		
23		1.6			.35-.50						0.11	0.33	0.18	0.51		
24		1.7			.35-.55						0.12	0.44	0.15	0.59		
25		1.7			.37-.47						0.11			.38-.46		
26		1.6			.37-.65						0.13	0.30	0.16	0.46		
27		1.5			.39-.54						0.14	0.29	0.16	0.45		
28		1.5			.42-.53						0.13	0.32	0.16	0.48		
29		1.4			.40-.57						0.14	0.30	0.15	0.45		
30		1.5			.40-.60						0.16	0.23	0.17	0.40		
31		1.6			.38-.56						0.21			.35-.56		

Free pre-chlorine residual high and low values taken from the Cl_2 analyzer charts. Fluoride residuals obtained from DWSP chemical analysis sheet. Total post chlorine residual high and low values taken from Kingston WTP monthly chemical usage summary sheets. Free, combined, and total post chlorine residuals taken from the laboratory daily log book.

TABLE 3.4: DISINFECTION PROFILE (OCT/1986)

DATE	PRE-CHLORINATION							POST-CHLORINATION							FLUORIDE	
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Dos.	Res.
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total		
1		1.7			.35-.70						0.09	0.35	0.16	0.51		
2		1.8			.40-.75						0.12			.36-.60		
3		1.6			.42-.62						0.15	0.28	0.16	0.44		
4		1.6			.43-.46						0.08	0.29	0.15	0.44		
5		1.6			.40-.50						0.08	0.39	0.16	0.55		
6		1.6			.35-.48						0.08			.35-.52		0.15
7		1.6			.41-.56						0.08	0.36	0.18	0.54		
8		1.7			.48-.68						0.14	0.41	0.16	0.57		
9		1.6			.51-.61						0.18			.34-.65		
10		1.6			.46-.54						0.07			.50-.60		
11		1.6			.50-.51						0.10	0.37	0.16	0.53		
12		1.6			.41-.59						0.11	0.41	0.19	0.60		
13		1.6			.48-.66						0.11	0.39	0.15	0.54		
14		1.5			.41-.61						0.13	0.33	0.17	0.50		
15		1.5			.46-.51						0.11	0.35	0.18	0.53		
16		1.5			.48-.54						0.12	0.32	0.16	0.48		
17		1.6			.43-.51						0.11			.40-.51		
18		1.6			.42-.48						0.11			.40-.51		
19		1.7			.48-.53						0.06			.43-.55		
20		1.7			.50-.55						0.06			.48-.56		
21		1.7			.48-.58						0.10			.47-.64		
22		1.7			.50-.60						0.13			.51-.64		
23		1.8			.40-.57						0.13			.36-.57		
24		1.6			.48-.72						0.21	0.42	0.20	0.62		
25		1.6			.52-.66						0.14	0.26	0.14	0.40		
26		1.7			.50-.60						0.14	0.29	0.17	0.46		
27		1.7			.42-.48						0.14	0.31	0.15	0.46		
28		1.7			.54-.60						0.17	0.27	0.18	0.45		
29		1.6			.44-.62						0.21	0.29	0.16	0.45		
30		1.6			.43-.58						0.14	0.27	0.18	0.45		
31		1.6			.48-.62						0.10	0.44	0.15	0.59		

Free pre-chlorine residual high and low values taken from the Cl_2 analyzer charts. Fluoride residuals obtained from DWSP chemical analysis sheet. Total post chlorine residual high and low values taken from Kingston WTP monthly chemical usage summary sheets. Free, combined, and total post chlorine residuals taken from the laboratory daily log book.

TABLE 3.5 DISINFECTION PROFILE (JAN/1985)

DATE	PRE-CHLORINATION							POST-CHLORINATION							FLUORIDE	
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Dos.	Res.
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total		
1		1.6			.39-.54						0.23			.32-.58		
2		1.6			.51-.66						0.29			.40-.57		
3		1.6			.49-.75						0.25			.31-.58		
4		1.4			.35-.51						0.12			.30-.56		
5		1.4			.50-.68						0.14			.33-.58		
6		1.4			.51-.60						0.15			.41-.54		
7		1.4			.50-.58						0.13			.36-.55		
8		1.4			.48-.60						0.16			.34-.55		
9		1.4			.46-.58						0.14			.43-.54		
10		1.4			.52-.58						0.18			.39-.58		
11		1.4			.46-.62						0.18			.30-.55		
12		1.4			.62-.74						0.30			.40-.55		
13		1.3			.63-.69						0.32			.40-.55		
14		1.3			.56-.72						0.26			.35-.64		
15		1.3			.48-.75						0.19			.32-.62		
16		1.3			.49-.63						0.16			.34-.63		
17		1.3			.61-.73						0.26			.30-.61		
18		1.2			.48-.58						0.21			.41-.60		
19		1.2			.51-.56						0.19			.35-.56		
20		1.2			.47-.65						0.20			.35-.55		
21		1.2			.49-.66						0.22			.38-.62		
22		1.2			.42-.55						0.19			.34-.68		
23		1.2			.45-.62						0.17			.41-.58		
24		1.2			.44-.57						0.16			.35-.55		
25		1.3			.48-.60						0.23			.35-.62		
26		1.3			.47-.58						0.25			.33-.64		
27		1.2			.50-.58						0.22			.35-.53		
28		1.2			.42-.61						0.22			.35-.59		
29		1.2			.45-.56						0.23			.35-.57		
30		1.3			.46-.70						0.27			.30-.62		
31		1.3			.45-.70						0.26			.37-.58		

Free pre-chlorine residual high and low values taken from the Cl_2 analyzer charts. Total post chlorine residual high and low values taken from Kingston WTP monthly chemical usage summary sheets.

TABLE 3.6: DISINFECTION PROFILE (APR/1985)

DATE	PRE-CHLORINATION							POST-CHLORINATION							FLUORIDE	
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2				
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total	Dos.	Res.
1		1.6			.44-.58						0.15			.28-.55		
2		1.5			.44-.58						0.20			.36-.59		
3		1.5			.40-.64						0.16			.33-.62		
4		1.5			.46-.66						0.19			.34-.63		
5		1.5			.41-.78						0.16			.34-.65		
6		1.5			.54-.74						0.14			.41-.57		
7		1.6			.51-.60						0.14			.30-.55		
8		1.5			.41-.64						0.26			.36-.59		
9		1.4			.54-.76						0.24			.28-.49		
10		1.7			.54-.66						0.19			.33-.61		
11		1.7			.48-.71						0.22			.30-.46		
12		1.7			.46-.59						0.23			.40-.55		
13		1.8			.53-.65						0.22			.31-.65		
14		1.9			.44-.57						0.17			.26-.59		
15		1.9			.36-.62						0.22			.30-.63		
16		1.8			.52-.78						0.22			.32-.53		
17		1.8			.38-.75						0.18			.33-.62		
18		1.9			.34-.73						0.08			.31-.58		
19		2.0			.36-.57						0.19			.34-.58		
20		2.0			.39-.77						0.30			.32-.55		
21		1.9			.51-.70						0.27			.36-.58		
22		1.8			.58-.74						0.23			.31-.60		
23		1.7			.47-.77						0.27			.40-.56		
24		1.6			.57-.64						0.22			.30-.51		
25		1.7			.49-.76						0.18			.31-.58		
26		1.6			.45-.64						0.24			.33-.52		
27		1.6			.48-.62						0.22			.42-.59		
28		1.6			.54-.62						0.23			.44-.59		
29		1.6			.48-.63						0.34			.43-.55		
30		1.6			.58-.68						0.29			.35-.59		
31																

Free pre-chlorine residual low and high values taken from the Cl_2 analyzer charts. Total post chlorine residual low and high values taken from Kingston WTP monthly chemical usage summary sheets. Chlorine and sulphur dioxide doses taken from "Water Condition and Chemicals Used" monthly summary.

TABLE 3.7: DISINFECTION PROFILE (JUL/1985)

DATE	PRE-CHLORINATION							POST-CHLORINATION							FLUORIDE	
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Dos.	Res.
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total		
1		1.8			.41-.55						0.14			.43-.55		
2		1.9			.47-.60						0.18			.35-.53		0.11
3		1.8			.47-.59						0.17			.41-.55		
4		1.8			.43-.57						0.25			.35-.54		
5		1.9			.49-.65						0.18			.40-.59		
6		1.8			.55-.56						0.14			.33-.57		
7		1.8			.40-.70						0.18			.38-.59		
8		1.7			.40-.61						0.17			.39-.60		
9		1.8			.40-.55						0.15			.31-.54		
10		1.8			.44-.61						0.11			.41-.60		
11		1.7			.41-.54						0.20			.40-.54		
12		1.7			.40-.62						0.20			.33-.54		
13		1.7			.48-.57						0.19			.38-.60		
14		1.8			.42-.70						0.10			.34-.54		
15		1.8			.44-.66						0.19			.32-.55		
16		1.8			.51-.53						0.12			.30-.52		
17		1.8			.43-.65						0.13			.35-.60		
18		1.8			.55-.66						0.11			.37-.57		
19		1.9			.43-.70						0.19			.42-.60		
20		1.7			.40-.61						0.15			.38-.56		
21		1.8			.40-.69						0.14			.35-.56		
22		1.9			.45-.65						0.14			.30-.64		
23		2.0			.51-.69						0.18			.31-.62		
24		1.9			.50-.62						0.22			.38-.56		
25		1.8			.52-.57						0.23			.30-.59		
26		1.8			.45-.56						0.25			.34-.58		
27		1.8			.52-.70						0.19			.38-.55		
28		1.7			.42-.67						0.16			.31-.56		
29		1.7			.48-.52						0.21			.31-.55		
30		1.8			.50-.59						0.33			.30-.57		
31		1.8			.55-.66						0.32					

Free pre-chlorine residual high and low values taken from the Cl_2 analyzer charts. Fluoride residuals obtained from DWSP chemical analysis sheet. Total post chlorine residual high and low values taken from Kingston WTP monthly chemical usage summary sheets.

TABLE 3.7: DISINFECTION PROFILE (JUL/1985)

DATE	PRE-CHLORINATION							POST-CHLORINATION							FLUORIDE	
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Dos.	Res.
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total		
1		1.8			.41-.55						0.14			.43-.55		
2		1.9			.47-.60						0.18			.35-.53		0.11
3		1.8			.47-.59						0.17			.41-.55		
4		1.8			.43-.57						0.25			.35-.54		
5		1.9			.49-.65						0.18			.40-.59		
6		1.8			.55-.56						0.14			.33-.57		
7		1.8			.40-.70						0.18			.38-.59		
8		1.7			.40-.61						0.17			.39-.60		
9		1.8			.40-.55						0.15			.31-.54		
10		1.8			.44-.61						0.11			.41-.60		
11		1.7			.41-.54						0.20			.40-.54		
12		1.7			.40-.62						0.20			.33-.54		
13		1.7			.48-.57						0.19			.38-.60		
14		1.8			.42-.70						0.10			.34-.54		
15		1.8			.44-.66						0.19			.32-.55		
16		1.8			.51-.53						0.12			.30-.52		
17		1.8			.43-.65						0.13			.35-.60		
18		1.8			.55-.66						0.11			.37-.57		
19		1.9			.43-.70						0.19			.42-.60		
20		1.7			.40-.61						0.15			.38-.56		
21		1.8			.40-.69						0.14			.35-.56		
22		1.9			.45-.65						0.14			.30-.64		
23		2.0			.51-.69						0.18			.31-.62		
24		1.9			.50-.62						0.22			.38-.56		
25		1.8			.52-.57						0.23			.30-.59		
26		1.8			.45-.56						0.25			.34-.58		
27		1.8			.52-.70						0.19			.38-.55		
28		1.7			.42-.67						0.16			.31-.56		
29		1.7			.48-.52						0.21			.31-.55		
30		1.8			.50-.59						0.33			.30-.57		
31		1.8			.55-.66						0.32					

Free pre-chlorine residual high and low values taken from the Cl_2 analyzer charts. Fluoride residuals obtained from DWSP chemical analysis sheet. Total post chlorine residual high and low values taken from Kingston WTP monthly chemical usage summary sheets.

TABLE 3.8: DISINFECTION PROFILE (OCT/1985)

DATE	PRE-CHLORINATION							POST-CHLORINATION							FLUORIDE	
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Dos.	Res.
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total		
1		1.9			.42-.68						0.31			.32-.59		
2		1.9			.51-.73						0.29			.32-.55		
3		1.7			.39-.75						0.22			.40-.62		
4		1.7			.49-.54						0.17			.44-.57		
5		1.7			.52-.69						0.29			.31-.55		
6		1.7			.41-.63						0.17			.30-.47		
7		1.8			.46-.69						0.20			.35-.62		0.14
8		1.8			.55-.71						0.33			.37-.51		
9		1.8			.49-.64						0.33			.33-.47		
10		1.7			.54-.71						0.32			.35-.55		
11		1.7			.45-.65						0.28			.34-.54		
12		1.7			.46-.59						0.19			.31-.49		
13		1.8			.40-.56						0.25			.35-.56		
14		1.7			.50-.65						0.25			.42-.56		
15		1.5			.40-.59						0.21			.38-.50		
16		1.5			.41-.57						0.12			.49-.54		
17		1.7			.44-.62						0.14			.42-.61		
18		1.6			.39-.58						0.22			.39-.49		
19		1.6			.38-.74						0.21			.32-.58		
20		1.6			.45-.62						0.18			.32-.56		
21		1.6			.41-.59						0.17			.30-.53		
22		1.6			.45-.73						0.17			.41-.59		
23		1.6			.43-.63						0.19			.40-.57		
24		1.6			.48-.59						0.21			.42-.50		
25		1.6			.30-.50						0.20			.35-.60		
26		1.7			.48-.57						0.25			.38-.52		
27		1.6			.43-.75						0.22			.36-.61		
28		1.6			.41-.62						0.18			.40-.52		
29		1.6			.49-.64						0.18			.38-.59		
30		1.6			.33-.69						0.20			.38-.56		
31		1.7			.41-.67						0.19			.40-.55		

Free pre-chlorine residual high and low values taken from the Cl_2 analyzer charts. Fluoride residuals obtained from DWSP chemical analysis sheet. Total post chlorine residual high and low values taken from Kingston WTP monthly chemical usage summary sheets.

TABLE 3.9: DISINFECTION PROFILE (JAN/1984)

DATE	PRE-CHLORINATION							POST-CHLORINATION							FLUORIDE	
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Dos.	Res.
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total		
1		1.3			.42-.57						0.23			.35-.56		
2		1.3			.40-.59						0.20			.40-.52		
3		1.3			.42-.68						0.22			.34-.48		
4		1.2			.47-.70						0.28			.35-.57		
5		1.3			.45-.65						0.21			.38-.57		
6		1.2			.48-.58						0.18			.37-.59		
7		1.2			.45-.60						0.18			.34-.54		
8		1.2			.44-.60						0.17			.34-.53		
9		1.2			.45-.60						0.21			.38-.56		
10		1.2			.50-.66						0.19			.40-.51		
11		1.2			.46-.56						0.23			.30-.46		
12		1.2			.42-.55						0.23			.28-.49		
13		1.2			.38-.58						0.17			.32-.46		
14		1.4			.40-.61						0.25			.37-.54		
15		1.5			.52-.68						0.30			.35-.56		
16		1.4			.48-.68						0.29			.34-.54		
17		1.5			.50-.70						0.22			.35-.63		
18		1.4			.54-.60						0.32			.32-.57		
19		1.3			.50-.70						0.26			.35-.58		
20		1.3			.45-.54						0.24			.30-.55		
21		1.3			.41-.58						0.14			.32-.56		
22		1.3			.47-.67						0.25			.37-.57		
23		1.2			.47-.66						0.29			.30-.62		
24		1.2			.44-.68						0.17			.39-.55		
25		1.3			.44-.62						0.23			.40-.55		
26		1.2			.44-.59						0.19			.34-.56		
27		1.3			.43-.60						0.18			.36-.50		
28		1.3			.44-.57						0.19			.31-.44		
29		1.3			.47-.52						0.18			.35-.49		
30		1.3			.49-.70						0.25			.36-.54		
31		1.3			.51-.64						0.23			.36-.53		

Free pre-chlorine residual high and low values taken from the Cl_2 analyzer charts. Total post chlorine residual high and low values taken from Kingston WTP monthly chemical usage summary sheets.

TABLE 3.10: DISINFECTION PROFILE (APR/1984)

DATE	PRE-CHLORINATION							POST-CHLORINATION							FLUORIDE	
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Dos.	Res.
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total		
1		1.6			.54-.64						0.29			.30-.52		
2		1.6			.49-.59						0.36			.31-.41		
3		1.4			.48-.75						0.41			.32-.55		
4		1.3			.47-.66						0.28			.32-.55		
5		1.3			.47-.61						0.27			.33-.54		
6		1.3			.40-.56						0.25			.31-.61		
7		1.3			.43-.53						0.21			.30-.55		
8		1.4			.45-.58						0.16			.36-.56		
9		1.5			.46-.59						0.21			.32-.52		
10		1.5			.34-.60						0.22			.32-.50		
11		1.5			.38-.47						0.24			.33-.51		
12		1.6			.44-.62						0.29			.30-.48		
13		1.6			.45-.61						0.29			.32-.52		
14		1.6			.45-.61						0.32			.30-.50		
15		1.7			.39-.70						0.28			.30-.55		
16		1.7			.46-.64						0.25			.35-.51		
17		1.7			.49-.63						0.20			.44-.64		
18		1.6			.50-.66						0.22			.46-.61		
19		1.6			.36-.56						0.18			.30-.56		
20		1.7			.49-.67						0.18			.38-.62		
21		1.7			.46-.64						0.13			.42-.59		
22		1.7			.40-.57						0.20			.30-.50		
23		1.8			.45-.66						0.21			.38-.58		
24		1.8			.47-.62						0.20			.40-.56		
25		1.6			.45-.57						0.25			.35-.56		
26		1.4			.47-.73						0.24			.35-.62		
27		1.4			.49-.66						0.23			.40-.56		
28		1.4			.52-.58						0.19			.40-.56		
29		1.5			.50-.63						0.15			.40-.57		
30		1.5			.40-.58						0.12			.31-.58		
31																

Free pre-chlorine residual high and low values taken from the Cl_2 analyzer charts. Total post chlorine residual high and low values taken from Kingston WTP monthly chemical usage summary sheets.

TABLE 3.11: DISINFECTION PROFILE (JUL/1984)

DATE	PRE-CHLORINATION							POST-CHLORINATION							FLUORIDE	
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2				
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total	Dos.	Res.
1		2.0			.45-.79						0.33			.39-.57		
2		2.0			.45-.68						0.27			.39-.60		
3		2.1			.46-.62						0.28			.41-.55		
4		2.1			.46-.67						0.26			.37-.62		
5		2.0			.50-.61						0.27			.40-.59		
6		2.0			.46-.70						0.31			.35-.59		
7		2.1			.46-.50						0.24			.35-.45		
8		2.1			.47-.59						0.22			.35-.54		
9		2.1			.48-.56						0.21			.39-.55		
10		2.1			.47-.53						0.17			.36-.49		
11		2.1			.48-.60						0.20			.35-.61		
12		2.1			.48-.59						0.15			.35-.59		
13		2.0			.50-.63						0.16			.35-.63		
14		2.1			.56-.72						0.24			.34-.63		
15		2.1			.49-.60						0.16			.38-.57		
16		2.1			.48-.68						0.20			.36-.56		
17		2.2			.55-.73						0.28			.30-.54		
18		2.1			.49-.74						0.23			.35-.60		
19		2.2			.50-.68						0.32			.36-.57		
20		2.2			.49-.70						0.28			.38-.59		
21		2.2			.46-.59						0.18			.36-.53		
22		2.2			.45-.61						0.24			.35-.56		
23		2.2			.46-.56						0.24			.41-.60		
24		2.2			.49-.70						0.18			.45-.61		
25		2.0			.46-.80						0.18			.38-.66		
26		2.0			.50-.80						0.31			.37-.66		
27		2.1			.45-.69						0.21			.32-.62		
28		2.1			.50-.70						0.34			.37-.56		
29		2.0			.53-.70						0.19			.35-.56		
30		2.0			.45-.64						0.13			.35-.58		
31		2.1			.49-.63						0.23			.30-.56		

Free pre-chlorine residual high and low values taken from the Cl_2 analyzer charts. Total post chlorine residual high and low values taken from Kingston WTP monthly chemical usage summary sheets.

TABLE 3.12: DISINFECTION PROFILE (OCT/1984)

DATE	PRE-CHLORINATION							POST-CHLORINATION							FLUORIDE	
	Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Cl_2		NH_3	SO_2	RESIDUAL Cl_2			Dos.	Res.
	Dem.	Dos.			Free	Comb.	Total	Dem.	Dos.			Free	Comb.	Total		
1		1.8			.40-.64						0.26			.39-.57		
2		1.7			.38-.70						0.27			.33-.60		
3		1.7			.46-.73						0.28			.37-.52		
4		1.9			.31-.70						0.14			.35-.51		
5		1.7			.50-.68						0.27			.34-.51		
6		1.6			.42-.59						0.22			.42-.60		
7		1.6			.36-.70						0.24			.35-.57		
8		1.8			.43-.66						0.23			.40-.54		
9		1.7			.44-.72						0.21			.37-.58		
10		1.6			.42-.72						0.24			.38-.50		
11		1.7			.39-.70						0.27			.31-.55		
12		1.7			.44-.69						0.28			.35-.57		
13		1.8			.43-.71						0.28			.32-.55		
14		1.8			.43-.68						0.28			.36-.58		
15		1.8			.50-.72						0.27			.35-.53		
16		1.8			.51-.63						0.25			.35-.57		
17		1.8			.35-.70						0.19			.43-.58		
18		1.8			.45-.66						0.34			.30-.55		
19		1.8			.46-.72						0.27			.43-.55		
20		1.7			.49-.69						0.23			.34-.52		
21		1.7			.47-.71						0.21			.41-.55		
22		1.6			.50-.60						0.21			.39-.46		
23		1.6			.43-.62						0.21			.40-.59		
24		1.6			.47-.69						0.22			.40-.55		
25		1.6			.44-.57						0.21			.41-.52		
26		1.6			.46-.64						0.20			.30-.55		
27		1.7			.42-.60						0.12			.34-.59		
28		1.8			.44-.52						0.13			.35-.59		
29		1.8			.45-.60						0.18			.41-.58		
30		1.8			.44-.64						0.35			.35-.55		
31		1.6			.45-.70						0.24			.32-.58		

Free pre-chlorine residual high and low values taken from the Cl_2 analyzer charts. Total post chlorine residual high and low values taken from Kingston WTP monthly chemical usage summary sheets.

GENERAL CHEMISTRY		1986			1985			1984			198_			DWSP DETECTION LIMIT	DRINKING WATER OBJ. GUIDELINE[1]
		MAX	MIN	AVG	MAX	MIN	AVG	MAX	MIN	AVG	MAX	MIN	AVG		
GENERAL CHEMISTRY															
Alkalinity (mg/L)	R	141.5	91.2	105.1	98.2	93.0	96.0							0.2 (mg/L)	
	T	106.2	89.5	95.3	92.2	86.8	90.3								
Ammonium (Total) (mg/L)	R	0.044	-	0.018	-	-	-							0.002 (mg/L)	
	T	0.016	-	0.01	-	-	-								
Calcium (mg/L)	R	56.6	37.7	41.8	38.2	36	37.5							0.1 (mg/L)	
	T	42.3	38.0	39.8	38.5	36.8	37.8								
Chloride (mg/L)	R	24.5	17.5	22.9	23.8	21.0	22.3							0.2 (mg/L)	250 (mg/L)
	T	25.5	19.35	23.8	25.4	22.4	23.8								
Colour (TCU)	R	9	1.5	4	6.5	1.5	5							0.5 (TCU)	5 (TCU)
	T	3.5	0.5	1.5	1.5	0.5	1								
Conductivity (umho/cm)	R	410	298	331	321	304	313							0.01 (umho/cm)	
	T	334	297	324	330	314	321								
Field Chlorine (Combined)	R													0.1 (mg/L)	
	T	0.180	0.120	0.150	0.170	0.100	0.140								
Field Chlorine (Free)	R													0.1 (mg/L)	
	T	0.420	0.150	0.320	0.500	0.230	0.340								
Field Chlorine (Total)	R													0.1 (mg/L)	
	T	0.540	0.380	0.480	0.650	0.330	0.480								
Field pH	R	8.30	7.60	7.91	8.15	7.80	7.93							0.2	
	T	7.60	7.40	7.51	7.40	7.55	7.44								

NOTE: Information obtained from DWSP results.

GENERAL CHEMISTRY (cont'd.)		1986			1985			1984			198_			DWSP DETECTION LIMIT	DRINKING WATER OBJ. GUIDELINE[1]
		MAX	MIN	AVG	MAX	MIN	AVG	MAX	MIN	AVG	MAX	MIN	AVG		
Field Temperature (^{o}C)	R	17.0	0.1	8.4	17.2	6.0	13.3								
	T	18.0	0.4	8.8	19.0	6.0	13.8								
Field Turbidity (FTU)	R	2.00	0.50	0.96	2.50	0.82	1.27								<1 (FTU)
	T	0.46	0.06	1.47	0.13	0.06	0.09								
Fluoride (mg/L)	R	0.20	0.11	0.15	0.16	0.12	0.14							0.01 (mg/L)	2.4 (mg/L)
	T	0.15	0.10	0.14	0.14	0.11	0.12								
Hardness (mg/L)	R	182.5	126.5	138.3	129.5	123	126							0.5 (mg/L)	
	T	139.5	129	132.5	130	126	128								
Magnesium (mg/L)	R	10.10	6.8	8.27	8.3	7.4	7.9							0.05 (mg/L)	c
	T	8.8	6.75	8.05	8.35	7.6	8.0								
Nitrate (mg/L)	R	0.375	0.200	0.298	0.20	0.15	0.18							0.05 (mg/L)	10 (mg/L as N)
	T	0.375	0.03	0.259	0.25	0.10	0.18								
Nitrite (mg/L)	R	.005	-	.003	-	-	-							0.001 (mg/L)	1 (mg/L as N)
	T	.004	-	.003	-	-	-								
Nitrogen Total Kjeldahl (mg/L)	R	0.33	0.07	0.21	0.46	0.30	0.38							0.02 (mg/L)	0.15 (mg/L) *
	T	0.23	0.14	0.17	0.30	0.20	0.28								
pH	R	8.35	7.91	8.24	8.26	7.94	8.12								
	T	8.17	7.69	7.99	7.8	7.55	7.65								
Phosphorus Filtered Reactive (mg/L)	R													0.01 (mg/L)	
	T														

NOTE: Information obtained from DWSP results.

METALS (cont'd.)		1986 MAX	1986 MIN	1986 AVG	1985 MAX	1985 MIN	1985 AVG	1984 MAX	1984 MIN	1984 AVG	198_ MAX	198_ MIN	198_ AVG	DWSP DETECTION LIMIT	DRINKING WATER OBJ. GUIDELINE[1]
Chromium (mg/l)	R	0.003	<.001	0.001	0.003	<.001	0.002							0.5 (ug/L)	0.05 (mg/L)
	T	0.002	<.001	0.001	0.002	<.001	0.001								
Cobalt (mg/L)	R	0.001	<.001	<.001	0.001	<.001	<.001							0.5 (ug/L)	
	T	0.001	<.001	<.001	0.001	<.001	<.001								
Copper (mg/L)	R	0.220	0.062	0.097	0.14	0.001	0.059							0.5 (ug/L)	1 (mg/L)
	T	0.004	0.001	0.002	0.004	0.001	0.002								
Cyanide (mg/L)	R	-	-	-	-	-	-							0.001 (mg/L)	0.2 (mg/L)
	T	-	-	-	-	-	-								
Iron (mg/L)	R	0.036	<.001	0.019	0.160	<.001	0.044							0.002 (mg/L)	0.3 (mg/L) c
	T	0.018	<.001	0.005	0.028	<.001	0.007								
Lead (mg/L)	R	0.007	<.003	0.007	<.003	<.003	<.003							0.005 (mg/L)	0.05 (mg/L)
	T	<.005	<.003	<.003	<.003	<.003	<.003								
Manganese (mg/L)	R	0.048	0.001	0.010	0.016	-	0.008							0.001 (mg/L)	0.05 (mg/L)
	T	0.001	-	0.001	0.001	-	0.001								
Molybdenum (mg/L)	R	0.002	-	0.001	0.002	-	.0015							0.5 (ug/L)	
	T	0.002	-	0.001	0.002	0.001	.0015								
Mercury (ug/L)	R	0.01	<0.01	0.01	0.02	<.01	0.013							0.01 (ug/L)	1 (ug/L)
	T	0.02	<0.01	0.01	0.02	0.01	0.013								
Nickel (mg/L)	R	0.002	0.001	0.002	0.003	<.001	0.002							0.002 (mg/L)	
	T	0.002	0.001	0.002	0.003	<.001	0.002								

NOTE: Information obtained from DWSP results.

PURGEABLES (cont'd.)		1986 MAX	1986 MIN	1986 AVG	1985 MAX	1985 MIN	1985 AVG	1984 MAX	1984 MIN	1984 AVG	198_ MAX	198_ MIN	198_ AVG	DWSP DETECTION LIMIT	DRINKING WATER OBJ. GUIDELINE[1]
Chlorodibromomethane (ug/L)	R	-	-	-	-	-	-	-	-	-				1 (ug/L)	350 (ug/L) ++
	T	24	2	8.2	21	4	10.3	6	4	5					
Chloroform (ug/L)	R	-	-	-	-	-	-	48	-	-				1 (ug/L)	350 (ug/L) ++
	T	39	11	20.5	34	16	25.4	31	15	21					
1,2-Dichlorobenzene (ug/L)	R	-	-	-	-	-	-							1 (ug/L)	400 (ug/L) e
	T	-	-	-	-	-	-								
1,3-Dichlorobenzene (ug/L)	R	-	-	-	-	-	-							1 (ug/L)	400 (ug/L) e
	T	-	-	-	-	-	-								
1,4-Dichlorobenzene (ug/L)	R	-	-	-	-	-	-							1 (ug/L)	400 (ug/L) e
	T	-	-	-	-	-	-								
Dichlorobromomethane (ug/L)	R	-	-	-	-	-	-							1 (ug/L)	350 (ug/L) ++
	T	15	8	11.3	21	12	15.5								
1,1-Dichloroethane (ug/L)	R	-	-	-	-	-	-							1 (ug/L)	
	T	-	-	-	-	-	-								
1,2-Dichloroethane (ug/L)	R	-	-	-	-	-	-							1 (ug/L)	10 (ug/L) h
	T	-	-	-	-	-	-								
1,1-Dichloroethylene (ug/L)	R	-	-	-	-	-	-							1 (ug/L)	0.3 (ug/L) h
	T	-	-	-	-	-	-								
T,1,2-Dichloroethylene (ug/L)	R	-	-	-	-	-	-							1 (ug/L)	
	T	-	-	-	-	-	-								

NOTE: Information obtained from DWSP results.

PURGEABLES (cont'd.)		1986 MAX	1986 MIN	1986 AVG	1985 MAX	1985 MIN	1985 AVG	1984 MAX	1984 MIN	1984 AVG	198_ MAX	198_ MIN	198_ AVG	DWSP DETECTION LIMIT	DRINKING WATER OBJ. GUIDELINE[1]
1,1,1-Trichloroethane (ug/L)	R	-	-	-	-	-	-							1 (ug/L)	1000 (ug/L) c
	T	-	-	-	-	-	-								
1,1,2-Trichloroethane (ug/L)	R	-	-	-	-	-	-							1 (ug/L)	6 (ug/L) e
	T	-	-	-	-	-	-								
Trichloroethylene (ug/L)	R	-	-	-	-	-	-	-	-	-				1 (ug/L)	30 (ug/L) h
	T	-	-	-	-	-	-	-	-	-					
Total Trihalomethanes (ug/L)	R	-	-	-	-	-	-	52	-	-				3 (ug/L)	350 (ug/L) ++
	T	51	28	40	77	34	50.4	56	37	43					
Trifluorochloro-toluene (ug/L)	R	-	-	-	-	-	-							1 (ug/L)	
	T	-	-	-	-	-	-								
ORGANOCHLORINES															
Aldrin (ng/L)	R	-	-	-	-	-	-							1 (ng/L)	700 (ng/L) **
	T	-	-	-	-	-	-								
Alpha BHC (ng/L)	R	-	-	-	-	-	-							1 (ng/L)	700 (ng/L) c
	T	-	-	-	-	-	-								
Alpha Chlordane (ng/L)	R	-	-	-	-	-	-							2 (ng/L)	700 (ng/L) ***
	T	-	-	-	-	-	-								
Beta BHC (ng/L)	R	-	-	-	-	-	-							1 (ng/L)	300 (ng/L) c
	T	-	-	-	-	-	-								
Dieldrin (ng/L)	R	-	-	-	-	-	-							2 (ng/L)	700 (ng/L) **
	T	-	-	-	-	-	-								

NOTE: Information obtained from DWSP results.

ORGANOCHLORINES (cont'd.)		1986			1985			1984			198_			DWSP DETECTION LIMIT	DRINKING WATER OBJ. GUIDELINE[1]
		MAX	MIN	AVG	MAX	MIN	AVG	MAX	MIN	AVG	MAX	MIN	AVG		
Octachlorostyrene (ng/L)	R	-	-	-	-	-	-							1 (ng/L)	
	T	-	-	-	-	-	-								
O,P-DDT (ng/L)	R	-	-	-	-	-	-							5 (ng/L)	30000 (ng/L) d
	T	-	-	-	-	-	-								
Oxychlordane (ng/L)	R	-	-	-	-	-	-							2 (ng/L)	
	T	-	-	-	-	-	-								
PCB Total (ng/L)	R	-	-	-	-	-	-							20 (ng/L)	3000 (ng/L) t
	T	-	-	-	-	-	-								
Pentachlorobenzene (ng/L)	R	-	-	-	-	-	-							1 (ng/L)	74000 (ng/L) e
	T	-	-	-	-	-	-								
P,P-DDD (ng/L)	R	-	-	-	-	-	-							5 (ng/L)	d
	T	-	-	-	-	-	-								
P,P-DDE (ng/L)	R	-	-	-	-	-	-							1 (ng/L)	d
	T	-	-	-	-	-	-								
P,P-DDT (ng/L)	R	-	-	-	-	-	-							5 (ng/L)	d
	T	-	-	-	-	-	-								
1,2,3,4-Tetra-chlorobenzene (ng/L)	R	-	-	-	-	-	-							1 (ng/L)	
	T	-	-	-	-	-	-								
1,2,3,5-Tetra-chlorobenzene (ng/L)	R	-	-	-	-	-	-							1 (ng/L)	
	T	-	-	-	-	-	-								

NOTE: Information obtained from DWSP results.

TRIAZINES		1986			1985			1984			198_			DWSP DETECTION LIMIT	DRINKING WATER OBJ. GUIDELINE[1]
		MAX	MIN	AVG	MAX	MIN	AVG	MAX	MIN	AVG	MAX	MIN	AVG		
TRIAZINES															
2,6,A-Trichlorotoluene (ng/L)	R	-	-	-	-	-	-							5 (ng/L)	
	T	-	-	-	-	-	-								
Alachlor (ng/L)	R														
	T														
Ametrine (ng/L)	R	-	-	-										50 (ng/L)	
	T	-	-	-											
Atratone (ng/L)	R	-	-	-											
	T	-	-	-											
Atrazine (ng/L)	R	-	-	-										50 (ng/L)	46000 (ng/L) !
	T	-	-	-											
Bladex (ng/L)	R	-	-	-										100 (ng/L)	10000 (ng/L) !
	T	-	-	-											
Metolachlor (ng/L)	R	-	-	-											
	T	-	-	-											
Prometone (ng/L)	R	-	-	-										50 (ng/L)	
	T	-	-	-											
Prometryne (ng/L)	R	-	-	-										50 (ng/L)	1000 (ng/L) !
	T	-	-	-											
Propazine (ng/L)	R	-	-	-										50 (ng/L)	
	T	-	-	-											

NOTE: Information obtained from DWSP results.

SPECIAL PESTICIDES (cont'd.)		1986			1985			1984			198_			DWSP DETECTION LIMIT	DRINKING WATER OBJ. GUIDELINE[1]
		MAX	MIN	AVG	MAX	MIN	AVG	MAX	MIN	AVG	MAX	MIN	AVG		
2,3,4,5-Tetra-chlorophenol (ng/L)	R	-	-	-	-	-	-							50 (ng/L)	
	T	-	-	-	-	-	-								
2,3,5,6-Tetra-chlorophenol (ng/L)	R	-	-	-	-	-	-							50 (ng/L)	
	T	-	-	-	-	-	-								
2,3,4-Trichlorophenol (ng/L)	R	-	-	-	-	-	-							100 (ng/L)	
	T	-	-	-	-	-	-								
2,4,5-Trichlorophenol (ng/L)	R	-	-	-	-	-	-							50 (ng/L)	
	T	-	-	-	-	-	-								
2,4,6-Trichlorophenol (ng/L)	R	-	-	-	-	-	-							50 (ng/L)	10000 (ng/L) h
	T	-	-	-	-	-	-								
ORGANOPHOSPHOROUS PEST'S.															
Diazinon (ng/L)	R				-	-	-							50 (ng/L)	14000 (ng/L)
	T				-	-	-								
Dichlorovos (ng/L)	R				-	-	-								
	T				-	-	-								
Dursban (ng/L)	R				-	-	-								
	T				-	-	-								
Ethion (ng/L)	R				-	-	-								
	T				-	-	-								
Guthion (ng/L)	R				-	-	-								
	T				-	-	-								

NOTE: Information obtained from DWSP results.

MASS SPEC. (cont'd.)		1986			1985			1984			198_			DWSP DETECTION LIMIT	DRINKING WATER OBJ. GUIDELINE[1]
		MAX	MIN	AVG	MAX	MIN	AVG	MAX	MIN	AVG	MAX	MIN	AVG		
N-Dichloromethylene-Pentachloroanaline (ug/L)	R													0.1 (ug/L)	
	T														
Diphenyl Ether (ug/L)	R													0.1 (ug/L)	
	T														
Fluoranthene (ug/L)	R													0.1 (ug/L)	
	T														
Hexachloropropene (ug/L)	R													0.1 (ug/L)	
	T														
Methyl Phenanthrene (ug/L)	R													0.1 (ug/L)	
	T														
Naphthalene (ug/L)	R													0.1 (ug/L)	
	T														
Pentachlorobutadiene (ug/L)	R													0.1 (ug/L)	
	T														
Pentachloropropane (ug/L)	R													0.1 (ug/L)	
	T														
Pentachloropropene (ug/L)	R													0.1 (ug/L)	
	T														
Pyrene (ug/L)	R													0.1 (ug/L)	
	T														

NOTE: Information obtained from DWSP results.

BACTERIA (cont'd.)		1986			1985			1984			198_			DWSP DETECTION LIMIT	DRINKING WATER OBJ GUIDELINE[1]
		MAX	MIN	AVG	MAX	MIN	AVG	MAX	MIN	AVG	MAX	MIN	AVG		
Treated Water (cont'd.)															
Standard Plate Count MF (count/100 mL)	T	580	0	86.3											
If Present/Absent Test Positive:															
Coliform P/A	R														
	T						-								
Fecal Coliform P/A	R														
	T						-								
E. Coli P/A	R														
	T														
Aromonas P/A	R														
	T						-								
Staph. Aureus P/A	R														
	T						-								

NOTE: Information obtained from DWSP results.

TABLE 4.0 - FOOTNOTES

DWSP samples are collected once a month.

1	= see individual footnotes for agency of guideline origin
c	= California State Department of Health action level
d	= OWDO for DDT (contains other isomers such as OPDDT and PPDDT)
e	= USEPA ambient guideline
ea	= United States Environmental Protection Agency (USEPA) ambient level for endosulfan (contains other isomers)
ep	= USEPA proposed maximum contaminant level for drinking water
g	= suggested Health and Welfare Canada/Ontario Ministry of the Environment guideline value
h	= World Health Organization (WHO) guideline
h*	= World Health Organization (WHO) odour threshold
mg/L	= milligrams per litre, parts per million (ppm)
ng/L	= nanograms per litre, parts per trillion (ppt)
Presence/Absence	= microbiological test to indicate presence or absence of coliform bacteria
R	= raw water
T	= treated drinking water
t	= ODWO interim maximum acceptable concentration (IMAC)
ug/L	= micrograms per litre, parts per billon (ppb)
y	= New York State (taste and odour) proposed drinking water guideline
++	= total trihalomethanes
+++	= combined total: heptachlor and heptachlor epoxide
*	= if other than DWSP detection limit
**	= total of aldrin and dieldrin
***	= chlordane is a mixture of alpha and gamma isomers
!	= Ministry of the Environment and Health and Welfare Canada (IMAC)
-	= No quantifiable results. This includes readings that are non-detectable and readings that are detected but not quantifiable.
G	= ODWO suggested guideline

GENERAL CHEMISTRY		1986 JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	OWSP DETECTION LIMIT	DRINKING WATER OBJ GUIDELINE[1]
GENERAL CHEMISTRY															
Alkalinity (mg/L)	R	97.2	98.0	96.6	100.5	105.3	102.4	98	102.3	111.2	N/A	91.2	108.7	0.2 (mg/L)	
	T	91.8	92.6	90.8	94.3	98.9	96.2	92.1	94.7	89.5	91.3	106.2	95.9		
Ammonium (Total) (mg/L)	R	0.028	0.022	0.01	0.014	0.020	0.034	0.044	0.024	0.012	-	0.01	-	0.002 (mg/L)	
	T	0.028	0.014	0.004	0.008	0.008	0.006	-	0.016	-	0.012	0.02	-		
Calcium (mg/L)	R	40.0	38.5	39	40.9	41.3	40.9	39.4	40.0	44.4	N/A	37.7	41.3	0.1 (mg/L)	
	T	40.0	38.0	39	40.4	41.3	40.1	39.6	39.8	38.2	38.8	42.3	38.3		
Chloride (mg/L)	R	22.2	23.8	24.0	22.70	17.50	21.50	24.00	23.5	23.50	23.00	24.5	23.4	0.2 (mg/L)	250 (mg/L)
	T	23.2	25.0	24.8	24.10	19.35	23.00	25.50	24.5	25.0	24.00	23	24.3		
Colour (TCU)	R	5.5	5.0	4.0	2.5	9.0	5.0	2.5	3.0	2.5	3.5	1.5	4.0	0.5 (TCU)	5 (TCU)
	T	-	-	-	-	3.5	1.5	-	-	-	-	-	-		
Conductivity (umho/cm)	R	314	329	322	320	298	323	326	322	338	410	315	335	0.01 (umho/cm)	
	T	318	334	325	325	297	327	330	322	315	324	332	325		
Field Chlorine (Combined)	R													0.1 (mg/L)	
	T	0.130	0.130	0.120	0.130	0.190	0.130	0.120	0.120	0.180	0.170	0.170	0.160		
Field Chlorine (Free)	R													0.1 (mg/L)	
	T	0.400	0.150	0.380	0.320	0.260	0.340	0.420	0.350	0.270	0.300	0.320	0.350		
Field Chlorine (Total)	R													0.1 (mg/L)	
	T	0.530	0.380	0.500	0.450	0.450	0.470	0.540	0.470	0.450	0.470	0.490	0.510		
Field pH	R	7.90	8.10	7.85	7.98	8.10	7.90	8.30	7.70	7.60	7.80	7.90	7.80	0.2	
	T	7.40	7.55	7.50	7.55	7.50	7.45	7.55	7.40	7.45	7.60	7.60	7.55		

NOTE: Information obtained from OWSP results.

GENERAL CHEMISTRY (cont'd.)		1986 JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DWSP DETECTION LIMIT	DRINKING WATER OBJ. GUIDELINE[1]
Field Temperature (^{o}C)	R	0.6	0.5	0.1	2.0	7.1	8.2	16.0	17.0	14.8	17.0	12.0	6.0		
	T	0.6	0.5	0.4	2.0	7.1	11.0	16.0	18.0	15.3	16.0	12.0	7.0		
Field Turbidity (FTU)	R	2.00	1.00	0.80	1.30	0.71	0.75	0.60	1.00	0.80	0.50	1.10	0.90		1 (FTU)
	T	0.10	0.07	0.06	0.09	0.20	0.08	0.09	0.08	0.46	0.08	0.08	0.08		
Fluoride (mg/L)	R	0.15	0.14	0.16	0.15	0.11	0.15	0.16	0.15	0.12	0.20	0.14	0.15	0.01 (mg/L)	2.4 (mg/L)
	T	0.12	0.14	0.14	0.14	0.10	0.13	0.14	0.13	0.12	0.15	0.15	0.13		
Hardness (mg/L)	R	132.0	130.3	133	134	131	134	131.5	134	146	N/A	126.5	138.5	0.5 (mg/L)	
	T	133.0	129.1	134	134	131	131.5	131.5	135	128	130.0	139.5	129.0		
Magnesium (mg/L)	R	7.9	8.3	8.7	7.95	6.80	7.80	8.05	8.3	8.55	10.10	7.80	8.60	0.05 (mg/L)	c
	T	8.1	8.3	8.8	8.10	6.75	7.65	7.90	8.65	7.95	8.00	8.25	8.10		
Nitrate (mg/L)	R		0.365	0.375	0.325	0.345	0.335	0.270	0.255	0.290	0.200	0.235	0.270	0.05 (mg/L)	10 (mg/L as N)
	T		0.355	0.375	0.320	0.335	0.305	0.250	0.250	0.030	0.130	0.205	0.295		
Nitrite (mg/L)	R	0.002	0.002	-	.005	.003	.005	.004	-	.003	.004	-	-	0.001 (mg/L)	1 (mg/L as N)
	T	0.002	-	-	.004	-	.004	.003	-	.002	.004	-	-		
Nitrogen Total Kjeldahl (mg/L)	R	0.26	0.19	0.19	0.23	.33	0.26	0.26	0.21	0.17	0.20	0.07	0.16	0.02 (mg/L)	0.15 (mg/L) *
	T	0.19	0.15	0.14	0.15	.23	0.15	0.18	0.18	0.19	0.19	0.18	0.14		
pH	R	8.11	8.13	8.20	8.32	8.35	8.27	8.31	8.35	8.30	8.23	7.91	8.22		
	T	7.60	7.69	7.72	8.05	8.08	7.98	8.00	8.08	8.08	8.10	8.17	8.04		
Phosphorus Filtered Reactive (mg/L)	R													0.01 (mg/L)	
	T														

NOTE: Information obtained from DWSP results.

GENERAL CHEMISTRY (cont'd.)		1986 JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DWSP DETECTION LIMIT	DRINKING WATER OBJ. GUIDELINE[1]
Phosphorus (total) (mg/l)	R	0.018	0.007	0.006	0.015	0.009	0.012	0.014	0.018	0.021	0.024	0.002	0.013	0.002 (mg/l)	
	T		-	-	-	-		0.018	-	0.006	-	0.010	-		
Sodium (mg/l)	R	11.5	12.5	12.0	12.0	9.2	11.5	12.0	12.0	12.1	12.6	11.9	10.3	0.2 (mg/L)	
	T	11.5	12.0	12.0	12.2	9.5	11.2	12.0	12.2	12.1	12.0	12.3	10.8		
Total Solids (mg/L)	R													1 (mg/L)	
	T														
Turbidity (FTU)	R	1.7	1.48	0.62	1.80	0.57	0.80	0.86	1.57	0.81	0.47	1.06	1.03	0.02 (FTU)	<1 (FTU)
	T	0.08	0.18	0.05	0.45	0.08	0.20	0.79	0.21	0.15	0.15	0.10	0.15		
METALS															
Aluminum (mg/L)	R	0.05	0.028	0.034	0.056	0.004	0.029	0.004	0.017	0.005	0.036	0.042	0.02	0.003 (mg/L)	
	T	0.072	0.065	0.063	0.071	0.150	0.085	0.230	0.11	0.044	0.170	0.130	0.071		G
Arsenic (mg/l)	R	0.001	0.001	0.002	<.001	<.001	<.001	0.002	<.001	<.001	<.001	<.001	<.001	0.001 (mg/l)	0.05 (mg/l)
	T	<.001	<.001	0.001	<.001	<.001	<.001	0.001	<.001	<.001	<.001	<.001	<.001		
Barium (mg/L)	R	0.019	0.019	0.018	0.019	0.026	0.022	0.021	0.031	0.046	0.060	0.039	0.031	0.001 (mg/L)	1 (mg/L)
	T	0.018	0.019	0.018	0.017	0.024	0.021	0.021	0.020	0.023	0.023	0.025	0.022		
Beryllium (mg/L)	R	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	0.005 (mg/L)	
	T	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001		
Boron (mg/l)	R	0.04	0.05	0.09	<0.08	0.03	0.03	0.03	0.03	0.04	0.04	0.02	0.02	0.005 (mg/l)	5 (mg/l)
	T	<0.02	0.05	0.05	<0.08	0.03	0.03	0.03	0.03	0.03	0.03	0.02	0.04		
Cadmium (ug/L)	R	<.2	<.2	<.2	<.2	<.3	<.3	<.3	<.3	<.3	<.3	<.3	<.3	0.3 (ug/L)	0.005 (mg/l)
	T	<.2	<.2	<.2	<.2	<.3	<.3	<.3	<.3	<.3	<.3	<.3	<.3		

NOTE: Information obtained from DWSP results.

METALS (cont'd.)		1986 JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DWSP DETECTION LIMIT*	DRINKING WATER OBJ GUIDELINE[1]
Chromium	R	0.003	0.002	0.002	0.003	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	0.5	0.05
(mg/L)	T	0.002	0.002	0.002	0.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	(ug/L)	(mg/L)
Cobalt	R	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	0.001	<.001	<.001	0.5	
(mg/L)	T	<.001	0.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	(ug/L)	
Copper	R	0.076	0.066	0.071	0.064	0.081	0.097	0.062	0.110	0.170	0.220	0.076	0.076	0.5	1
(mg/L)	T	0.003	0.004	0.003	0.004	0.002	0.002	0.001	0.001	0.001	0.002	0.001	0.003	(ug/L)	(mg/L)
Cyanide	R	-	-	-	-	-	-	-	-	-	-	-	-	0.001	0.2
(mg/L)	T	-	-	-	-	-	-	-	-	-	-	-	-	(mg/L)	(mg/L)
Iron	R	0.036	0.012	0.015	0.036	0.024	0.014	<.001	0.015	0.012	0.015	0.025	0.02	0.002	0.03
(mg/L)	T	<.003	0.004	<.003	<.003	0.015	<.002	0.002	<.001	0.001	0.007	0.018	0.005	(mg/L)	(mg/L) c
Lead	R	<.003	<.003	<.003	<.003	<.003	<.003	<.003	<.003	<.003	0.007	0.004	<.003	0.005	0.05
(mg/L)	T	<.003	<.003	<.003	<.003	<.003	<.003	<.003	<.003	<.003	<.005	<.003	<.003	(mg/L)	(mg/L)
Manganese	R	0.004	0.003	0.002	0.004	0.003	0.005	0.003	0.001	0.015	0.048	0.015	0.006	0.001	0.05
(mg/L)	T	0.001	0.001	0.001	0.001	0.001	<.001	0.001	-	-	-	-	-	(mg/L)	(mg/L)
Molybdenum	R	0.002	<.001	<.001	0.001	-	<.001	0.001	-	0.001	0.001	0.001	0.001	0.5	
(mg/L)	T	0.002	0.001	<.001	0.001	-	<.001	0.001	0.001	0.001	0.001	0.001	0.001	(ug/L)	
Mercury	R	<0.01	<0.01	0.01	0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	0.01	1
(ug/L)	T	0.01	<0.01	0.02	<0.01	0.01	<0.01	<0.01	<0.01	0.01	0.02	0.01	<0.01	(ug/L)	(ug/L)
Nickel	R	0.002	0.002	0.001	0.002	0.002	0.002	<.002	0.002	<.002	<.002	<.002	<.002	0.002	
(mg/L)	T	0.001	0.002	0.002	0.001	0.002	<.002	<.002	<.002	0.002	0.002	<.002	<.002	(mg/L)	

NOTE: Information obtained from DWSP results.

METALS (cont'd.)		1986 JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DWSP DETECTION LIMIT	DRINKING WATER OBJ. GUIDELINE[1]
Selenium (mg/L)	R	.001	.001	.001	.001	.001	.001	.001	.001	.001	.001	.001	.001	0.001 (mg/L)	0.01 (mg/L)
	T	.001	.001	.001	.001	.001	.001	.001	.001	.001	.001	.001	.001		
Strontium (mg/L)	R	0.180	0.160	0.170	0.170	0.190	0.160	0.180	0.470	0.850	N/A	0.540	0.490	0.001 (mg/L)	
	T	0.170	0.180	0.170	0.170	0.190	0.160	0.180	0.160	0.170	0.180	0.180	0.180		
Tin (no units available)	R	-	-	-	-	-	-	-	-	-	-	-	-		
	T	-	-	-	-	-	-	-	-	-	-	-	-		
Uranium * (ug/L)	R	2	2	2	2	2	-	-	0.35	0.31	0.36	0.33	0.33	0.1 (ug/L)	0.02 (mg/L) t
	T	2	2	2	2	2	-	-	0.27	0.27	0.33	0.29	0.29		
Vanadium (mg/L)	R	.001	.001	.001	.001	-	.001	-	-	-	-	-	-	0.001 (mg/L)	
	T	.001	.001	.001	.001	-	.001	-	-	.001	-	-	-		
Zinc (mg/L)	R	0.003	0.005	0.006	0.004	0.002	0.005	0.001	0.004	0.005	0.003	0.003	0.005	0.5 (ug/L)	5 (mg/L) h
	T	0.002	0.004	0.001	0.003	0.003	0.002	0.004	0.003	0.001	0.001	0.006	0.005		
PURGEABLES															
Benzene (ug/L)	R		-	-	-	-	-	-	-	-	-	-	-	1 (ug/L)	10 (ug/L) h
	T		-	-	-	-	-	-	-	-	-	-	-		
Bromoform (ug/L)	R		-	-	-	-	-	-	-	-	-	-	-	1 (ug/L)	350 (ug/L) ++
	T		-	-	-	-	-	-	-	-	-	-	-		
Carbon Tetrachloride (ug/L)	R			-	-	-	-	-	-	-	-	-	-	1 (ug/L)	3 (ug/L) h
	T			-	-	-	-	-	-	-	-	-	-		
Chlorobenzene (ug/L)	R		-	-	-	-	-	-	-	-	-	-	-	1 (ug/L)	100-300 (ng/L) h*
	T		-	-	-	-	-	-	-	-	-	-	-		

NOTE: Information obtained form DWSP results.
* Detection limit was changed during 1986 from 2 µg/L to 0.1 µg/L.

PURGEABLES (cont'd.)		1986 JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DWSP DETECTION LIMIT*	DRINKING WATER OBJ GUIDELINE[1]
Chlorodibromomethane	R		-	-	-	-	-	-	-	-	-	-*	-	1	350
(ug/L)	T		13	24	13	3	2	9	6	5	2	-	5	(ug/L)	(ug/L) ++
Chloroform	R		-	-	-	-	-	-	-	-	-	-*	-	1	350
(ug/L)	T		11	14	23	39	24	23	20	14	15	-	22	(ug/L)	(ug/L) ++
1,2-Dichlorobenzene	R		-	-	-	-	-	-	-	-	-	-	-	1	400
(ug/L)	T		-	-	-	-	-	-	-	-	-	-	-	(ug/L)	(ug/L) e
1,3-Dichlorobenzene	R		-	-	-	-	-	-	-	-	-	-	-	1	400
(ug/L)	T		-	-	-	-	-	-	-	-	-	-	-	(ug/L)	(ug/L) e
1,4-Dichlorobenzene	R		-	-	-	-	-	-	-	-	-	-	-	1	400
(ug/L)	T		-	-	-	-	-	-	-	-	-	-	-	(ug/L)	(ug/L) e
Dichlorobromomethane	R		-	-	-	-	-	-	-	-	-	-*	-	1	350
(ug/L)	T		9	11	13	9	8	15	14	11	11	-	12	(ug/L)	(ug/L) ++
1,1-Dichloroethane	R		-	-	-	-	-	-	-	-	-	-	-	1	
(ug/L)	T		-	-	-	-	-	-	-	-	-	-	-	(ug/L)	
1,2-Dichloroethane	R		-	-	-	-	-	-	-	-	-	-	-	1	10
(ug/L)	T		-	-	-	-	-	-	-	-	-	-	-	(ug/L)	(ug/L) h
1,1-Dichloroethylene	R		-	-	-	-	-	-	-	-	-	-	-	1	0.3
(ug/L)	T		-	-	-	-	-	-	-	-	-	-	-	(ug/L)	(ug/L) h
1,1,2-Dichloroethylene	R		-	-	-	-	-	-	-	-	-	-	-	1	
(ug/L)	T		-	-	-	-	-	-	-	-	-	-	-	(ug/L)	

NOTE: Information obtained from DWSP results.
* Data missing due to wrong description on sample bottle.

PURGEABLES (cont'd.)		1986 JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DWSP DETECTION LIMIT	DRINKING WATEP OBJ. GUIDELINE[1]
Dichloromethane (ug/L)	R		-	-	-	-	-	-	-	-	-	-	-	5 (ug/L)	40 (ug/L) c
	T		-	-	-	-	-	-	-	-	-	-	-		
1,2-Dichloropropane (ug/L)	R		-	-	-	-	-	-	-	-	-	-	-	1 (ug/L)	
	T		-	-	-	-	-	-	-	-	-	-	-		
Ethylbenzene (ug/L)	R		-	-	-	-	-	-	-	-	-	-	-	1 (ug/L)	1400 (ug/L) e
	T		-	-	-	-	-	-	-	-	-	-	-		
Ethylene Dibromide (ug/L)	R					-	-	-	-	-	-	-	-		
	T					-	-	-	-	-	-	-	-		
M-Xylene (ug/L)	R		-	-	-	-	-	-	-	-	-	-	-	1 (ug/L)	620 (ug/L) c
	T		-	-	-	-	-	-	-	-	-	-	-		
O-Xylene (ug/L)	R		-	-	-	-	-	-	-	-	-	-	-	1 (ug/L)	620 (ug/L) c
	T		-	-	-	-	-	-	-	-	-	-	-		
P-Xylene (ug/L)	R		-	-	-	-	-	-	-	-	-	-	-	1 (ug/L)	620 (ug/L) c
	T		-	-	-	-	-	-	-	-	-	-	-		
Toluene (ug/L)	R		-	-	-	-	-	-	-	-	-	-	-	1 (ug/L)	100 (ug/L) c
	T		-	-	-	-	-	-	-	-	-	-	-		
1,1,2,2-Tetra-chloroethane (ug/L)	R		-	-	-	-	-	-	-	-	-	-	-	1 (ug/L)	1.7 (ug/L) e
	T		-	-	-	-	-	-	-	-	-	-	-		
Tetrachloroethane (ug/L)	R													1 (ug/L)	10 (ug/L) h
	T														

NOTE: Information obtained from DWSP results.

PURGEABLES (cont'd.)		1986 JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DWSP DETECTION LIMIT	DRINKING WATER OBJ GUIDELINE[1]
1,1,1-Trichloroethane (ug/L)	R		-	-	-	-	-	-		-	-	-	-	1 (ug/L)	1000 (ug/L) c
	T		-	-	-	-	-	-	-	-	-	-	-		
1,1,2-Trichloroethane (ug/L)	R		-	-	-	-	-	-	-	-	-	-	-	1 (ug/L)	6 (ug/L) e
	T		-	-	-	-	-	-	-	-	-	-	-		
Trichloroethylene (ug/L)	R		-	-	-	-	-	-	-	-	-	-	-	1 (ug/L)	30 (ug/L) h
	T		-	-	-	-	-	-	-	-	-	-	-		
Total Trihalomethanes (ug/L)	R		-	-	-	-	-	-	-	-	-	-*	-	3 (ug/L)	350 (ug/L) ++
	T		33	49	49	51	34	47	40	30	28	-	39		
Trifluorochloro-toluene (ug/L)	R		-	-	-	-	-	-	-	-	-	-	-	1 (ug/L)	
	T		-	-	-	-	-	-	-	-	-	-	-		
ORGANOCHLORINES															
Aldrin (ng/L)	R		-	-	-	-	-	-	-	-	-	-	-	1 (ng/L)	700 (ng/L) **
	T		-	-	-	-	-	-	-	-	-	-	-		
Alpha BHC (ng/L)	R		-	-	-	-	-	-	-	-	-	-	-	1 (ng/L)	700 (ng/L) c
	T		-	-	-	-	-	-	-	-	-	-	-		
Alpha Chlordane (ng/L)	R		-	-	-	-	-	-	-	-	-	-	-	2 (ng/L)	700 (ng/L) ***
	T		-	-	-	-	-	-	-	-	-	-	-		
Beta BHC (ng/L)	R		-	-	-	-	-	-		-	-	-	-	1 (ng/L)	300 (ng/L) c
	T		-	-	-	-	-	-	-	-	-	-	-		
Dieldrin (ng/L)	R		-	-	-	-	-	-	-	-	-	-	-	2 (ng/L)	700 (ng/L) **
	T		-	-	-	-	-	-	-	-	-	-	-		

NOTE: Information obtained from DWSP results.
* Data missing due to wrong description on sample bottle.

ORGANOCHLORINES (cont'd.)		1986 JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DWSP DETECTION LIMIT	DRINKING WATER OBJ. GUIDELINE[1]
Endrin (ng/L)	R	-	-	-	-	-	-	-	-	-	-	-	-	4 (ng/L)	200 (ng/L)
	T	-	-	-	-	-	-	-	-	-	-	-	-		
Gamma Chlordane (ng/L)	R	-	-	-	-	-	-	-	-	-	-	-	-	2 (ng/L)	700 (ng/L) ***
	T	-	-	-	-	-	-	-	-	-	-	-	-		
Heptachlor Epoxide (ng/L)	R	-	-	-	-	-	-	-	-	-	-	-	-	1 (ng/L)	3000 (ng/L) +++
	T	-	-	-	-	-	-	--	-	-	-	-	-		
Heptachlor (ng/L)	R	-	-	-	-	-	-	-	-	-	-	-	-	1 (ng/L)	3000 (ng/L) +++
	T	-	-	-	-	-	-	-	-	-	-	-	-		
Hexachlorobenzene (ng/L)	R	-	-	-	-	-	-	-	-	-	-	-	-	1 (ng/L)	10 (ng/L) h
	T	-	-	-	-	-	-	-	-	-	-	-	-		
Hexachlorobutadiene (ug/L)	R	-	-	-	-	-	-	-	-	-	-	-	-		
	T	-	-	-	-	-	-	-	-	-	-	-	-		
Hexachloroethane (ng/L)	R	-	-	-	-	-	-	-	-	-	-	-	-	1 (ng/L)	19000 (ng/L) e
	T	-	-	-	-	-	-	-	-	-	-	-	-		
Lindane (ng/L)	R													1 (ng/L)	4000 (ng/L)
	T														
Methoxychlor (ng/L)	R													5 (ng/L)	100000 (ng/L)
	T														
Mirex (ng/L)	R	-	-	-	-	-	-	-	-	-	-	-	-	5 (ng/L)	
	T	-	-	-	-	-	-	-	-	-	-	-	-		

NOTE: Information obtained from DWSP results.

ORGANOCHLORINES (cont'd.)		1986 JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DWSP DETECTION LIMIT	DRINKING WATER OBJ. GUIDELINE[1]
Octachlorostyrene (ng/L)	R	-	-	-	-	-	-	-	-	-	-	-	-	1 (ng/L)	
	T	-	-	-	-	-	-	-	-	-	-	-	-		
O,P-DDT (ng/L)	R	-	-	-	-	-	-	-	-	-	-	-	-	5 (ng/L)	30000 (ng/L) d
	T	-	-	-	-	-	-	-	-	-	-	-	-		
Oxychlordane (ng/L)	R	-	-	-	-	-	-	-	-	-	-	-	-	2 (ng/L)	
	T	-	-	-	-	-	-	-	-	-	-	-	-		
PCB Total (ng/L)	R	-	-	-	-	-	-	-	-	-	-	-	-	20 (ng/L)	3000 (ng/L) t
	T	-	-	-	-	-	-	-	-	-	-	-	-		
Pentachlorobenzene (ng/L)	R	-	-	-	-	-	-	-	-	-	-	-	-	1 (ng/L)	74000 (ng/L) e
	T	-	-	-	-	-	-	-	-	-	-	-	-		
P,P-DDD (ng/L)	R	-	-	-	-	-	-	-	-	-	-	-	-	5 (ng/L)	d
	T	-	-	-	-	-	-	-	-	-	-	-	-		
P,P-DDE (ng/L)	R	-	-	-	-	-	-	-	-	-	-	-	-	1 (ng/L)	d
	T	-	-	-	-	-	-	-	-	-	-	-	-		
P,P-DDT (ng/L)	R	-	-	-	-	-	-	-	-	-	-	-	-	5 (ng/L)	d
	T	-	-	-	-	-	-	-	-	-	-	-	-		
1,2,3,4-Tetra-chlorobenzene (ng/L)	R	-	-	-	-	-	-	-	-	-	-	-	-	1 (ng/L)	
	T	-	-	-	-	-	-	-	-	-	-	-	-		
1,2,3,5-Tetra-chlorobenzene (ng/L)	R	-	-	-	-	-	-	-	-	-	-	-	-	1 (ng/L)	
	T	-	-	-	-	-	-	-	-	-	-	-	-		

NOTE: Information obtained from DWSP results.

ORGANOCHLORINES (cont'd.)		1986 JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DWSP DETECTION LIMIT	DRINKING WATER OBJ. GUIDELINE[1]
1,2,4,5-Tetra-	R	-	-	-	-	-	-	-	-	-	-	-	-	1	38000
chlorobenzene (ng/L)	T	-	-	-	-	-	-	-	-	-	-	-	-	(ng/L)	(ng/L) e
Thiodan I	R													2	74000
(ng/L)	T													(ng/L)	(ng/L) ea
Thiodan II	R													4	74000
(ng/L)	T													(ng/L)	(ng/L) ea
Thiodan Sulphate	R													4	
(ng/L)	T													(ng/L)	
Toxaphene	R														
(no units available)	T														
1,2,3-Trichlorobenzene	R	-	-	-	-	-	-	-	-	-	-	-	-	5	10000
(ng/L)	T	-	-	-	-	-	-	-	-	-	-	-	-	(ng/L)	(ng/L) y
1,2,4-Trichlorobenzene	R	-	-	-	-	-	-	-	-	-	-	-	-	5	15000
(ng/L)	T	-	-	-	-	-	-	-	-	-	-	-	-	(ng/L)	(ng/L) y
1,3,5-Trichlorobenzene	R	-	-	-	-	-	-	-	-	-	-	-	-	5	10000
(ng/L)	T	-	-	-	-	-	-	-	-	-	-	-	-	(ng/L)	(ng/L) y
2,3,6-Trichlorotoluene	R	-	-	-	-	-	-	-	-	-	-	-	-	5	
(ng/L)	T	-	-	-	-	-	-	-	-	-	-	-	-	(ng/L)	
2,4,5-Trichlorotoluene	R	-	-	-	-	-	-	-	-	-	-	-	-	5	10000
(ng/L)	T	-	-	-	-	-	-	-	-	-	-	-	-	(ng/L)	(ng/L) g

NOTE: Information obtained from DWSP results.

TRIAZINES		1986 JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DWSP DETECTION LIMIT	DRINKING WATER OBJ. GUIDELINE[1]
TRIAZINES															
2,6,A-Trichlorotoluene	R	-	-	-	-	-	-	-	-	-	-	-	-	5	
(ng/L)	T	-	-	-	-	-	-	-	-	-	-	-	-	(ng/L)	
Alachlor	R														
(ng/L)	T														
Ametrine	R				-		-	-	-	-		-	-	50	
(ng/L)	T				-		-	-	-	-		-	-	(ng/L)	
Atratone	R						-	-	-	-		-	-		
(ng/L)	T						-	-	-	-		-	-		
Atrazine	R				-		120	-	-	-		-	-	50	46000
(ng/L)	T				-		-	-	-	-		-	-	(ng/L)	(ng/L) !
Bladex	R				100		100	100	100	100		100	100	100	10000
(ng/L)	T				100		100	100	100	100		100	100	(ng/L)	(ng/L) !
Metolachlor	R								500	500		500	500		
(ng/L)	T								500	500		500	500		
Prometone	R				-		-	-	-	-		-	-	50	
(ng/L)	T				-		-	-	-	-		-	-	(ng/L)	
Prometryne	R				-		-	-	-	-		-	-	50	1000
(ng/L)	T				-		-	-	-	-		-	-	(ng/L)	(ng/L) !
Propazine	R				-		-	-	-	-		-	-	50	
(ng/L)	T				-		-	-	-	-		-	-	(ng/L)	

NOTE: Information obtained from DWSP results.

TRIAZINES (cont'd.)		1986 JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DWSP DETECTION LIMIT	DRINKING WATER OBJ. GUIDELINE[1]
Sencor (ng/L)	R				-		-	-	-	-		-	-	100 (ng/L)	
	T				-		-	-	-	-		-	-		
Simazine (ng/l)	R				-		-	-	-	-		-	-	50 (ng/L)	10000 (ng/L) !
	T				-		-	-	-	-		-	-		
SPECIAL PESTICIDES															
2,4-D (ng/L)	R				-				-		-			100 (ng/L)	100000 (ng/L)
	T				-				-		-				
2,4-D Butyric Acid (ng/L)	R				-				-		-			200 (ng/L)	18000 (ng/L) !
	T				-				-		-				
Dicamba (ng/L)	R				-				-		-			100 (ng/L)	87000 (ng/L) !
	T				-				-		-				
Pentachlorophenol (ng/L)	R				-				-		-			50 (ng/L)	10000 (ng/L) h
	T				-				-		-				
Picloram (ng/L)	R													100 (ng/L)	
	T														
2,4-D Propionic Acid (ng/L)	R				-				-		-			100 (ng/L)	
	T				-				-		-				
Silvex (ng/L)	R				-				-		-			50 (ng/L)	10000 (ng/L)
	T				-				-		-				
2,4,5-T (ng/L)	R				-				-		-			50 (ng/L)	
	T				-				-		-				

NOTE: Information obtained from DWSP results.

SPECIAL PESTICIDES (cont'd.)		1986 JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DWSP DETECTION LIMIT	DRINKING WATER OBJ. GUIDELINE[1]
2,3,4,5-Tetra-	R				-				-		-			50	
chlorophenol (ng/L)	T				-				-		-			(ng/L)	
2,3,5,6-Tetra-	R				-				-		-			50	
chlorophenol (ng/L)	T				-				-		-			(ng/L)	
2,3,4-Trichlorophenol	R				-				-		-			100	
(ng/L)	T				-				-		-			(ng/L)	
2,4,5-Trichlorophenol	R				-				-		-			50	
(ng/L)	T				-				-		-			(ng/L)	
2,4,6-Trichlorophenol	R				-				-		-			50	10000
(ng/L)	T				-				-		-			(ng/L)	(ng/L) h
ORGANOPHOSPHOROUS PEST'S.															
Diazinon	R										-			50	14000
(ng/L)	T										-			(ng/L)	(ng/L)
Dichlorovos	R										-				
(ng/L)	T										-				
Dursban	R										-				
(ng/L)	T										-				
Ethion	R										-				
(ng/L)	T										-				
Guthion	R														
(ng/L)	T														

NOTE: Information obtained from DWSP results.

ORGANOPHOSPHOROUS PEST'S. (cont'd.)		1986 JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DWSP DETECTION LIMIT	DRINKING WATER OBJ. GUIDELINE[1]
Malathion (ng/L)	R										-				
	T										-				
Methylparathion (ng/L)	R										-			50 (ng/L)	7000 (ng/L)
	T										-				
Methyltrithion (ng/L)	R										-				
	T										-				
Mevinphos (ng/L)	R										-				
	T										-				
Parathion (ng/L)	R										-			50 (ng/L)	35000 (ng/L)
	T										-				
Phorbate (ng/L)	R										-				
	T										-				
Reldan (ng/L)	R										-				
	T										-				
Ronnel (ng/L)	R										-				
	T										-				
MASS SPEC.															
Di-N-Butyl Phthalate (ug/L)	R													0.1 (ug/L)	34000 (ug/L) e
	T														

NOTE: Information obtained from DWSP results.

MASS SPEC. (cont'd.)		1986												DWSP DETECTION LIMIT	DRINKING WATER OBJ GUIDELINE[1]
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		
N-Dichloromethylene-Pentachloroanaline (ug/L)	R													0.1 (ug/L)	
	T														
Diphenyl Ether (ug/L)	R													0.1 (ug/L)	
	T														
Fluoranthene (ug/L)	R													0.1 (ug/L)	
	T														
Hexachloropropene (ug/L)	R													0.1 (ug/L)	
	T														
Methyl Phenanthrene (ug/l)	R													0.1 (ug/L)	
	T														
Naphthalene (ug/L)	R													0.1 (ug/L)	
	T														
Pentachlorobutadiene (ug/L)	R													0.1 (ug/L)	
	T														
Pentachloropropane (ug/L)	R													0.1 (ug/L)	
	T														
Pentachloropropene (ug/L)	R													0.1 (ug/L)	
	T														
Pyrene (ug/L)	R													0.1 (ug/L)	
	T														

NOTE: Information obtained from DWSP results.

MASS SPEC. (cont'd.)		1986 JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DWSP DETECTION LIMIT	DRINKING WATER OBJ. GUIDELINE[1]
Tetrachlorbutane (ug/L)	R T													0.1 (ug/L)	
Tetrachlorobiphenyl (ug/L)	R T													0.1 (ug/L)	
BACTERIA															
Raw Water:															
Total Coliform MF	R		2	0	7	2	-	0	32	8	10	14	18		
Total Coliform BKGD	R		14	6	13	4	-	5	1900	380	210	314	102		
Fecal Coliform MF (count/100 mL)	R		0	0	0	0	-	0	5	2	0	2	0	0	0/0.1 (mL)
Standard Plate Count MF (count/mL)	R		3	3	11	11	11	-	127	>2400	640	136	21	0	500
Treated Water:															
Present/Absent Test	T					A	A	A	A	A	A	A	A		
Total Coliform Background MF (count/100 mL)	T					2	0	0	0	0	0	0	0	0	OWDO Bacti
Fecal Coliform MF (count/100 mL)	T					0	0	-	-	-	-	-	-	0	OWDO Bacti

NOTE: Information obtained from DWSP results.

BACTERIA (cont'd.)		1986 JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DWSP DETECTION LIMIT	DRINKING WATER OBJ GUIDELINE[1]
Treated Water (cont'd.)															
Standard Plate Count MF (count/100 mL)	T					1	-	580	0	9	8	0	6		
If Present/Absent Test Positive:															
Coliform P/A	R														
	T														
Fecal Coliform P/A	R														
	T														
E. Coli P/A	R														
	T														
Aromonas P/A	R														
	T														
Staph. Aureus P/A	R														
	T														

NOTE: Information obtained from DWSP results.
* If other than DWSP detection limit

TABLE 4.1 - FOOTNOTES

DWSP samples are collected once a month.

1	= see individual footnotes for agency of guideline origin
c	= California State Department of Health action level
d	= OWDO for DDT (contains other isomers such as OPDDT and PPDDT)
e	= USEPA ambient guideline
ea	= United States Environmental Protection Agency (USEPA) ambient level for endosulfan (contains other isomers)
ep	= USEPA proposed maximum contaminant level for drinking water
g	= suggested Health and Welfare Canada/Ontario Ministry of the Environment guideline value
h	= World Health Organization (WHO) guideline
h*	= World Health Organization (WHO) odour threshold
mg/L	= milligrams per litre, parts per million (ppm)
ng/L	= nanograms per litre, parts per trillion (ppt)
Presence/Absence	= microbiological test to indicate presence or absence of coliform bacteria
R	= raw water
T	= treated drinking water
t	= ODWO interim maximum acceptable concentration (IMAC)
ug/L	= micrograms per litre, parts per billon (ppb)
y	= New York State (taste and odour) proposed drinking water guideline
++	= total trihalomethanes
+++	= combined total: heptachlor and heptachlor epoxide
*	= if other than DWSP detection limit
**	= total of aldrin and dieldrin
***	= chlordane is a mixture of alpha and gamma isomers
!	= Ministry of the Environment and Health and Welfare Canada (IMAC)
-	= No quantifiable results. This includes readings that are non-detectable and readings that are detected but not quantifiable.
G	= ODWO suggested guideline

GENERAL CHEMISTRY		1985 JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DWSP DETECTION LIMIT	DRINKING WATER OBJ. GUIDELINE[1]
GENERAL CHEMISTRY															
Alkalinity (mg/L)	R						97.5	98.2	96.4	96.4	93.0	95	95.2	0.2 (mg/L)	
	T						91.7	92.2	90.8	91.4	86.8	89.6	89.4		
Ammonium (Total) (mg/L)	R							-	-	-	-	-	-	0.05 (mg/L)	
	T							-	-	-	-	-	-		
Calcium (mg/L)	R						38.2	37.8	36	38	36.6	37.5	37.5	0.1 (mg/L)	
	T						38.2	38.0	37	38	36.8	38.2	38.5		
Chloride (mg/L)	R							21.0	23.2	22.4	23.8	23.2	21.6	0.2 (mg/L)	250 (mg/L)
	T							22.4	24.8	24.0	25.4	24.4	23.4		
Colour (TCU)	R							5.0	5.0	1.5	4.0	4.5	6.5	0.5 (TCU)	5 (TCU)
	T							-	-	-	-	-	-		
Conductivity (umho/cm)	R						313	304	321	318	310	309	315	0.01 (umho/cm)	
	T						318	314	330	321	315	323	319		
Field Chlorine (Combined)	R													0.1 (mg/L)	
	T							0.130	0.150	0.150	0.140	0.170	0.100		
Field Chlorine (Free)	R													0.1 (mg/L)	
	T							0.400	0.500	0.340	0.320	0.250	0.230		
Field Chlorine (Total)	R													0.1 (mg/L)	
	T							0.530	0.650	0.490	0.480	0.420	0.330		
Field pH	R							7.90	7.85	7.80	8.15	8.00	7.90	0.2	
	T							7.55	7.40	7.40	7.50	7.40	7.40		

NOTE: Information obtained from DWSP results.

GENERAL CHEMISTRY (cont'd.)		1985 JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DWSP DETECTION LIMIT	DRINKING WATER OBJ. GUIDELINE[1]
Field Temperature	R							11.8	17.2	16.5	16.0	12.1	6.0		
(^{o}C)	T							12.0	19.0	17.0	16.5	12.1	6.0		
Field Turbidity	R							0.82	1.10	0.90	1.30	1.00	2.50		1
(FTU)	T							0.08	0.06	0.06	0.13	0.10	0.08		(FTU)
Fluoride	R						0.13	0.12	0.15	0.12	0.16	0.12	0.15	0.01	2.4
(mg/L)	T						0.12	0.11	0.12	0.12	0.14	0.12	0.12	(mg/L)	(mg/L)
Hardness	R						126	125	123	129.5	125	128	125	0.5	
(mg/L)	T						127	126	126	129.1	126	130	128	(mg/L)	
Magnesium	R						7.4	7.5	8.0	8.4	8.2	8.3	7.7	0.05	
(mg/L)	T						7.7	7.6	8.1	8.3	8.2	8.35	7.8	(mg/L)	c
Nitrates (Total)	R											.15	.20	0.05	10 (mg/L
(mg/L)	T											.10	.25	(mg/L)	as N)
Nitrite	R							-	-	-	-	-	-	0.001	1 (mg/L
(mg/L)	T							-	-	-	-	-	-	(mg/L)	as N)
Nitrogen Total	R							-	-	-	-	-	-	0.1	0.15
Kjeldahl (mg/L)	T							-	-	-	-	-	-	(mg/L)	(mg/L) *
pH	R						8.26	8.08	8.03	7.94	8.25	8.22	8.17		
	T						7.7	7.61	7.55	7.62	7.66	7.8	7.65		
Phosphorus Filtered	R													0.01	
Reactive (mg/L)	T													(mg/L)	

NOTE: Information obtained from DWSP results.

GENERAL CHEMISTRY (cont'd.)		1985 JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DWSP DETECTION LIMIT	DRINKING WATER OBJ. GUIDELINE[1]
Phosphorus (Total) (mg/L)	R							-	-	-	-	-	-	0.01 (mg/L)	
	T							-	-	-	-	-	-		
Sodium (mg/L)	R							12.0	11.5	11.5	12.3	12.5	12	0.1 (mg/L)	
	T							12.2	11.5	11.5	12.5	12.5	12.5		
Total Solids (mg/L)	R													1 (mg/L)	
	T														
Turbidity (FTU)	R						1.06	.99	2.0	.86	1.36	1.57	5	0.02 (FTU)	<1 (FTU)
	T						.18	.15	.12	.10	0.24	.10	.08		
METALS															
Aluminum (mg/L)	R							0.32	.004	.026	.033	.004	.160	0.003 (mg/L)	G
	T							0.10	.099	.097	.100	.110	.077		
Arsenic (mg/L)	R							-	-	-	-	-	-	0.001 (mg/L)	0.05 (mg/L)
	T							-	-	-	-	-	-		
Barium (mg/L)	R							.022	.022	.018	.018	-	.021	0.001 (mg/L)	1 (mg/L)
	T							.023	.023	.016	.018	.027	.018		
Beryllium (mg/L)	R							<.001	<.001	<.001	<.001	<.001	<.001	0.001 (mg/L)	
	T							<.001	<.001	<.001	<.001	<.001	<.001		
Boron (mg/L)	R							.32	.07	< .02	.08	.09	.02	0.02 (mg/L)	5 (mg/L)
	T							.27	< .02	< .02	.07	.08	< .02		
Cadmium (ug/L)	R							< .3	< .3	< .2	< .3	< .3	< .2	0.3 (ug/L)	0.005 (mg/L)
	T							< .3	< .3	< .2	< .3	< .3	< .2		

NOTE: Information obtained from DWSP results.

TABLE 4.2 (cont'd.)

METALS (cont'd.)		1985 JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DWSP DETECTION LIMIT*	DRINKING WATER OBJ. GUIDELINE[1]
Chromium (mg/L)	R							<.001	<.001	.002	.002	<.001	.003	0.5 (ug/L)	0.05 (mg/L)
	T							<.001	<.001	.001	.001	<.001	.002		
Cobalt (mg/L)	R							<.001	<.001	<.001	<.001	.001	.001	0.5 (ug/L)	
	T							<.001	<.001	<.001	<.001	.001	<.001		
Copper (mg/L)	R							.032	.027	.140	.066	.001	.087	0.001 (mg/L)	1 (mg/L)
	T							.002	.001	.004	.003	.001	.003		
Cyanide (mg/L)	R							-	-	-	-	-	-	0.001 (mg/L)	0.2 (mg/L)
	T							-	-	-	-	-	-		
Iron (mg/L)	R							.032	.019	.030	.020	<.001	.160	0.002 (mg/L)	0.03 (mg/L) c
	T							.028	<.001	<.003	<.002	.004	<.003		
Lead (mg/L)	R							<.003	<.003	<.003	<.003	<.003	<.003	0.005 (mg/L)	0.05 (mg/L)
	T							<.003	<.003	<.003	<.003	<.003	<.003		
Manganese (mg/L)	R							.008	.010	.007	.005	-	.016	0.001 (mg/L)	0.05 (mg/L)
	T							.001	-	<.001	.001	-	.001		
Molybdenum (mg/L)	R							.001	.001	.002	.002	-	.002	0.001 (mg/L)	
	T							.001	.001	.002	.002	.001	.002		
Mercury (ug/L)	R							.02	.01	.01	<.01	.01	.01	0.01 (ug/L)	1 (ug/L)
	T							.02	.01	.01	.01	.01	.01		
Nickel (mg/L)	R							<.002	<.002	.001	.001	<.002	.002	0.002 (mg/L)	
	T							.002	<.002	.002	<.001	<.002	.001		

NOTE: Information obtained from DWSP results.

METALS (cont'd.)		1985 JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DWSP DETECTION LIMIT	DRINKING WATER OBJ. GUIDELINE[1]
Selenium (mg/L)	R							<.001	<.001	<.001	<.001	<.001	<.001	0.001 (mg/L)	0.01 (mg/L)
	T							<.001	<.001	<.001	<.001	<.001	<.001		
Strontium (mg/L)	R							.170	.180	.150	.160	-	.170	0.001 (mg/L)	
	T							.180	.190	.140	.160	.210	.160		
Tin (no units available)	R							-	-	-	-	-	-		
	T							-	-	-	-	-	-		
Uranium (mg/L)	R							<.002	<.002	<.002	<.002	<.002	<.002	0.002 (mg/L)	0.02 (mg/L) t
	T							<.002	<.002	<.006	<.002	<.002	<.002		
Vanadium (mg/L)	R							-	-	<.001	<.001	-	<.001	0.001 (mg/L)	
	T							-	-	-	<.001	-	<.001		
Zinc (mg/L)	R							.003	.002	.005	.003	-	.006	0.5 (ug/L)	5 (mg/L) h
	T							.003	.003	.003	.003	.003	.004		
PURGEABLES															
Benzene (ug/L)	R							-	-	-	-	-	-	1 (ug/L)	10 (ug/L) h
	T							-	-	-	-	-	-		
Bromoform (ug/L)	R							-	-	-	-	-	-	1 (ug/L)	350 (ug/L) ++
	T							-	-	-	-	-	-		
Carbon Tetrachloride (ug/L)	R					-		-	-	-	-	-	-	1 (ug/L)	3 (ug/L) h
	T					-		-	-	-	-	-	-		
Chlorobenzene (ug/L)	R							-	-	-	-	-	-	1 (ug/L)	100-300 (ng/L) h*
	T							-	-	-	-	-	-		

NOTE: Information obtained from DWSP results.

PURGEABLES (cont'd.)		1985 JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DWSP DETECTION LIMIT*	DRINKING WATER OBJ GUIDELINE[1]
Chlorodibromomethane (ug/L)	R	-	-	-		-		-	-	-	-	-	-	1 (ug/L)	350 (ug/L) ++
	T	5	4	6		5		5	13	17	21	17	10		
Chloroform (ug/L)	R	-	-	-		-		-	-	-	-	-	-	1 (ug/L)	350 (ug/L) ++
	T	21	23	16		31		28	26	30	34	25	20		
1,2-Dichlorobenzene (ug/L)	R							-	-	-	-	-	-	1 (ug/L)	400 (ug/L) e
	T							-	-	-	-	-	-		
1,3-Dichlorobenzene (ug/L)	R							-	-	-	-	-	-	1 (ug/L)	400 (ug/L) e
	T							-	-	-	-	-	-		
1,4-Dichlorobenzene (ug/L)	R							-	-	-	-	-	-	1 (ug/L)	400 (ug/L) e
	T							-	-	-	-	-	-		
Dichlorobromomethane (ug/L)	R							-	-	-	-	-	-	1 (ug/L)	350 (ug/L) ++
	T							14	14	17	21	15	12		
1,1-Dichloroethane (ug/L)	R							-	-	-	-	-	-	1 (ug/L)	
	T							-	-	-	-	-	-		
1,2-Dichloroethane (ug/L)	R							-	-	-	-	-	-	1 (ug/L)	10 (ug/L) h
	T							-	-	-	-	-	-		
1,1-Dichloroethylene (ug/L)	R							-	-	-	-	-	-	1 (ug/L)	0.3 (ug/L) h
	T							-	-	-	-	-	-		
T,1,2-Dichloroethylene (ug/L)	R							-	-	-	-	-	-	1 (ug/L)	
	T							-	-	-	-	-	-		

NOTE: Information obtained from DWSP results.

PURGEABLES (cont'd.)		1985 JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DWSP DETECTION LIMIT	DRINKING WATER OBJ GUIDELINE[1]
Dichloromethane (ug/L)	R							-	-	-	-	-	-	5 (ug/L)	40 (ug/L) c
	T							-	-	-	-	-	-		
1,2-Dichloropropane (ug/L)	R							-	-	-	-	-	-	1 (ug/L)	
	T							-	-	-	-	-	-		
Ethylbenzene (ug/L)	R							-	-	-	-	-	-	1 (ug/L)	1400 (ug/L) e
	T							-	-	-	-	-	-		
Ethylene Dibromide (ug/l)	R														
	T														
M-Xylene (ug/l)	R							-	-	-	-	-	-	1 (ug/L)	620 (ug/L) c
	T							-	-	-	-	-	-		
O-Xylene (ug/L)	R							-	-	-	-	-	-	1 (ug/L)	620 (ug/L) c
	T							-	-	-	-	-	-		
P-Xylene (ug/L)	R							-	-	-	-	-	-	1 (ug/L)	620 (ug/l) c
	T							-	-	-	-	-	-		
Toluene (ug/l)	R							-	-	-	-	-	-	1 (ug/L)	100 (ug/L) c
	T							-	-	-	-	-	-		
1,1,2,2-Tetra-chloroethane (ug/L)	R							-	-	-	-	-	-	1 (ug/L)	1.7 (ug/l) e
	T							-	-	-	-	-	-		
Tetrachloroethane (ug/l)	R													1 (ug/L)	10 (ug/L) h
	T														

NOTE: Information obtained from DWSP results.

PURGEABLES (cont'd.)		1985 JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DWSP DETECTION LIMIT	DRINKING WATER OBJ GUIDELINE[1]
1,1,1-Trichloroethane (ug/L)	R							-	-	-	-	-	-	1 (ug/L)	1000 (ug/L) c
	T							-	-	-	-	-	-		
1,1,2-Trichloroethane (ug/L)	R							-	-	-	-	-	-	1 (ug/L)	6 (ug/L) e
	T							-	-	-	-	-	-		
Trichloroethylene (ug/L)	R					-		-	-	-	-	-	-	1 (ug/L)	30 (ug/L) h
	T					-		-	-	-	-	-	-		
Total Trihalomethanes (ug/L)	R	-	-	-				-	-	-	-	-	-	3 (ug/L)	350 (ug/L) ++
	T	40	40	34				47	53	64	77	57	42		
Trifluorochloro-toluene (ug/L)	R							-	-	-	-	-	-	1 (ug/L)	
	T							-	-	-	-	-	-		
ORGANOCHLORINES															
Aldrin (ng/L)	R							-	-	-	-	-	-	1 (ng/L)	700 (ng/L) **
	T							-	-	-	-	-	-		
Alpha BHC (ng/L)	R							-	-	-	-	-	-	1 (ng/L)	700 (ng/L) c
	T							-	-	-	-	-	-		
Alpha Chlordane (ng/L)	R							-	-	-	-	-	-	2 (ng/L)	700 (ng/L) ***
	T							-	-	-	-	-	-		
Beta BHC (ng/L)	R							-	-	-	-	-	-	1 (ng/L)	300 (ng/L) c
	T							-	-	-	-	-	-		
Dieldrin (ng/L)	R							-	-	-	-	-	-	2 (ng/L)	700 (ng/L) **
	T							-	-	-	-	-	-		

NOTE: Information obtained from DWSP results.

ORGANOCHLORINES (cont'd.)		1985 JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DWSP DETECTION LIMIT	DRINKING WATER OBJ. GUIDELINE[1]
Endrin (ng/L)	R							-	-	-	-	-	-	4 (ng/L)	200 (ng/L)
	T							-	-	-	-	-	-		
Gamma Chlordane (ng/L)	R							-	-	-	-	-	-	2 (ng/L)	700 (ng/L) ***
	T							-	-	-	-	-	-		
Heptachlor Epoxide (ng/L)	R							-	-	-	-	-	-	1 (ng/L)	3000 (ng/L) +++
	T							-	-	-	-	-	-		
Heptachlor (ng/L)	R							-	-	-	-	-	-	1 (ng/L)	3000 (ng/L) +++
	T							-	-	-	-	-	-		
Hexachlorobenzene (ng/L)	R							-	-	-	-	-	-	1 (ng/L)	10 (ng/L) h
	T							-	-	-	-	-	-		
Hexachlorobutadiene (ug/L)	R							-	-	-	-	-	-		
	T							-	-	-	-	-	-		
Hexachloroethane (ng/L)	R							-	-	-	-	-	-	1 (ng/L)	19000 (ng/L) e
	T							-	-	-	-	-	-		
Lindane (ng/L)	R													1 (ng/L)	4000 (ng/L)
	T														
Methoxychlor (ng/L)	R													5 (ng/L)	100000 (ng/L)
	T														
Mirex (ng/L)	R							-	-	-	-	-	-	5 (ng/L)	
	T							-	-	-	-	-	-		

NOTE: Information obtained from DWSP results.

ORGANOCHLORINES (cont'd.)		1985 JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DWSP DETECTION LIMIT	DRINKING WATER OBJ. GUIDELINE[1]
Octachlorostyrene (ng/L)	R							-	-	-	-	-	-	1 (ng/L)	
	T							-	-	-	-	-	-		
O,P-DDT (ng/L)	R							-	-	-	-	-	-	5 (ng/L)	30000 (ng/L) d
	T							-	-	-	-	-	-		
Oxychlordane (ng/L)	R							-	-	-	-	-	-	2 (ng/L)	
	T							-	-	-	-	-	-		
PCB Total (ng/L)	R							-	-	-	-	-	-	20 (ng/L)	3000 (ng/L) t
	T							-	-	-	-	-	-		
Pentachlorobenzene (ng/L)	R							-	-	-	-	-	-	1 (ng/L)	74000 (ng/L) e
	T							-	-	-	-	-	-		
P,P-DDD (ng/L)	R							-	-	-	-	-	-	5 (ng/L)	d
	T							-	-	-	-	-	-		
P,P-DDE (ng/L)	R							-	-	-	-	-	-	1 (ng/L)	d
	T							-	-	-	-	-	-		
P,P-DDT (ng/L)	R							-	-	-	-	-	-	5 (ng/L)	d
	T							-	-	-	-	-	-		
1,2,3,4-Tetra-chlorobenzene (ng/L)	R							-	-	-	-	-	-	1 (ng/L)	
	T							-	-	-	-	-	-		
1,2,3,5-Tetra-chlorobenzene (ng/L)	R							-	-	-	-	-	-	1 (ng/L)	
	T							-	-	-	-	-	-		

NOTE: Information obtained from DWSP results.

ORGANOCHLORINES (cont'd.)		1985 JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DWSP DETECTION LIMIT	DRINKING WATER OBJ. GUIDELINE[1]
1,2,4,5-Tetra-	R							-	-	-	-	-	-	1	38000
chlorobenzene (ng/L)	T							-	-	-	-	-	-	(ng/L)	(ng/L) e
Thiodan I	R													2	74000
(ng/L)	T													(ng/L)	(ng/L) ea
Thiodan II	R													4	74000
(ng/L)	T													(ng/L)	(ng/L) ea
Thiodan Sulphate	R													4	
(ng/L)	T													(ng/L)	
Toxaphene	R														
(no units available)	T														
1,2,3-Trichlorobenzene	R							-	-	-	-	-	-	5	10000
(ng/L)	T							-	-	-	-	-	-	(ng/L)	(ng/L) y
1,2,4-Trichlorobenzene	R							-	-	-	-	-	-	5	15000
(ng/L)	T							-	-	-	-	-	-	(ng/L)	(ng/L) y
1,3,5-Trichlorobenzene	R							-	-	-	-	-	-	5	10000
(ng/L)	T							-	-	-	-	-	-	(ng/L)	(ng/L) y
2,3,6-Trichlorotoluene	R							-	-	-	-	-	-	5	
(ng/L)	T							-	-	-	-	-	-	(ng/L)	
2,4,5-Trichlorotoluene	R							-	-	-	-	-	-	5	10000
(ng/L)	T							-	-	-	-	-	-	(ng/L)	(ng/L) g

NOTE: Information obtained from DWSP results

TRIAZINES		1985												DWSP DETECTION LIMIT	DRINKING WATER OBJ. GUIDELINE[1]
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		
TRIAZINES															
2,6,A-Trichlorotoluene (ng/L)	R							-	-	-	-	-	-	5 (ng/L)	
	T							-	-	-	-	-	-		
Alachlor (ng/L)	R														
	T														
Ametrine (ng/L)	R													50 (ng/L)	
	T														
Atratone (ng/L)	R														
	T														
Atrazine (ng/L)	R													50 (ng/L)	46000 (ng/L) !
	T														
Bladex (ng/L)	R													100 (ng/L)	10000 (ng/L) !
	T														
Metolachlor (ng/L)	R														
	T														
Prometone (ng/L)	R													50 (ng/L)	
	T														
Prometryne (ng/L)	R													50 (ng/L)	1000 (ng/L) !
	T														
Propazine (ng/L)	R													50 (ng/L)	
	T														

NOTE: Information obtained from DWSP results.

ORGANOCHLORINES (cont'd.)		1985 JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DWSP DETECTION LIMIT	DRINKING WATER OBJ. GUIDELINE[1]
1,2,4,5-Tetra-	R							-	-	-	-	-	-	1	38000
chlorobenzene (ng/L)	T							-	-	-	-	-	-	(ng/L)	(ng/L) e
Thiodan I	R													2	74000
(ng/L)	T													(ng/L)	(ng/L) ea
Thiodan II	R													4	74000
(ng/L)	T													(ng/L)	(ng/L) ea
Thiodan Sulphate	R													4	
(ng/L)	T													(ng/L)	
Toxaphene	R														
(no units available)	T														
1,2,3-Trichlorobenzene	R							-	-	-	-	-	-	5	10000
(ng/l)	T							-	-	-	-	-	-	(ng/L)	(ng/L) y
1,2,4-Trichlorobenzene	R							-	-	-	-	-	-	5	15000
(ng/L)	T							-	-	-	-	-	-	(ng/L)	(ng/L) y
1,3,5-Trichlorobenzene	R							-	-	-	-	-	-	5	10000
(ng/L)	T							-	-	-	-	-	-	(ng/L)	(ng/L) y
2,3,6-Trichlorotoluene	R							-	-	-	-	-	-	5	
(ng/L)	T							-	-	-	-	-	-	(ng/L)	
2,4,5-Trichlorotoluene	R							-	-	-	-	-	-	5	10000
(ng/l)	T							-	-	-	-	-	-	(ng/L)	(ng/L) g

NOTE: Information obtained from DWSP results

TRIAZINES		1985												DWSP DETECTION LIMIT	DRINKING WATER OBJ GUIDELINE[1]
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		
TRIAZINES															
2,6,A-Trichlorotoluene (ng/L)	R							-	-	-	-	-	-	5 (ng/L)	
	T							-	-	-	-	-	-		
Alachlor (ng/L)	R														
	T														
Ametrine (ng/L)	R													50 (ng/L)	
	T														
Atratone (ng/L)	R														
	T														
Atrazine (ng/L)	R													50 (ng/L)	46000 (ng/L) !
	T														
Bladex (ng/L)	R													100 (ng/L)	10000 (ng/L) !
	T														
Metolachlor (ng/L)	R														
	T														
Prometone (ng/L)	R													50 (ng/L)	
	T														
Prometryne (ng/L)	R													50 (ng/L)	1000 (ng/L) !
	T														
Propazine (ng/L)	R													50 (ng/L)	
	T														

NOTE: Information obtained from DWSP results.

TRIAZINES (cont'd.)		1985 JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DWSP DETECTION LIMIT	DRINKING WATER OBJ. GUIDELINE[1]
Sencor (ng/L)	R T													100 (ng/L)	
Simazine (ng/L)	R T													50 (ng/L)	10000 (ng/L) !
SPECIAL PESTICIDES															
2,4-D (ng/L)	R T							- -						100 (ng/L)	100000 (ng/L)
2,4-D Butyric Acid (ng/L)	R T							- -						200 (ng/L)	18000 (ng/L) !
Dicamba (ng/L)	R T							- -						100 (ng/L)	87000 (ng/L) !
Pentachlorophenol (ng/L)	R T							- -						50 (ng/L)	10000 (ng/L) h
Picloram (ng/L)	R T							- -						100 (ng/L)	
2,4-D Propionic Acid (ng/L)	R T							- -						100 (ng/L)	
Silvex (ng/L)	R T							- -						50 (ng/L)	10000 (ng/L)
2,4,5-T (ng/L)	R T							- -						50 (ng/L)	

NOTE: Information obtained from DWSP results.

SPECIAL PESTICIDES (cont'd.)		1985 JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DWSP DETECTION LIMIT	DRINKING WATER OBJ. GUIDELINE[1]
2,3,4,5-Tetra-chlorophenol (ng/L)	R							-						50 (ng/L)	
	T							-							
2,3,5,6-Tetra-chlorophenol (ng/L)	R							-						50 (ng/L)	
	T							-							
2,3,4-Trichlorophenol (ng/L)	R							-						100 (ng/L)	
	T							-							
2,4,5-Trichlorophenol (ng/L)	R							-						50 (ng/L)	
	T							-							
2,4,6-Trichlorophenol (ng/L)	R							-						50 (ng/L)	10000 (ng/L) h
	T							-							
ORGANOPHOSPHOROUS PEST'S.															
Diazinon (ng/L)	R							-						50 (ng/L)	14000 (ng/L)
	T							-							
Dichlorovos (ng/L)	R							-							
	T							-							
Dursban (ng/L)	R							-							
	T							-							
Ethion (ng/L)	R							-							
	T							-							
Guthion (ng/L)	R							-							
	T							-							

NOTE: Information obtained from DWSP results.

ORGANOPHOSPHOROUS PEST'S. (cont'd.)		1985 JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DWSP DETECTION LIMIT	DRINKING WATER OBJ. GUIDELINE[1]
Malathion (ng/L)	R							-							
	T							-							
Methylparathion (ng/L)	R							-						50 (ng/L)	7000 (ng/L)
	T							-							
Methyltrithion (ng/L)	R							-							
	T							-							
Mevinphos (ng/L)	R							-							
	T							-							
Parathion (ng/L)	R							-						50 (ng/L)	35000 (ng/L)
	T							-							
Phorbate (ng/L)	R														
	T														
Reldan (ng/L)	R							-							
	T							-							
Ronnel (ng/L)	R							-							
	T							-							
MASS SPEC.															
Di-N-Butyl Phthalate (ug/L)	R													0.1 (ug/L)	34000 (ug/L) e
	T														

NOTE: Information obtained from DWSP results.

MASS SPEC. (cont'd.)		1985												DWSP DETECTION LIMIT	DRINKING WATER OBJ. GUIDELINE[1]
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		
N-Dichloromethylene-Pentachloroanaline (ug/L)	R													0.1 (ug/L)	
	T														
Diphenyl Ether (ug/L)	R													0.1 (ug/L)	
	T														
Fluoranthene (ug/L)	R													0.1 (ug/L)	
	T														
Hexachloropropene (ug/L)	R													0.1 (ug/L)	
	T														
Methyl Phenanthrene (ug/L)	R													0.1 (ug/L)	
	T														
Naphthalene (ug/L)	R													0.1 (ug/L)	
	T														
Pentachlorobutadiene (ug/L)	R													0.1 (ug/L)	
	T														
Pentachloropropane (ug/L)	R													0.1 (ug/L)	
	T														
Pentachloropropene (ug/L)	R													0.1 (ug/L)	
	T														
Pyrene (ug/L)	R													0.1 (ug/L)	
	T														

NOTE: Information obtained from DWSP results.

MASS SPEC. (cont'd.)		1985 JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DWSP DETECTION LIMIT	DRINKING WATER OBJ. GUIDELINE[1]
Tetrachlorbutane (ug/L)	R T													0.1 (ug/L)	
Tetrachlorobiphenyl (ug/L)	R T													0.1 (ug/L)	
BACTERIA															
Raw Water:															
Total Coliform MF	R							4	4	6	12	21	32		
Total Coliform BKGD	R							105	90	42	34	39	78		
Fecal Coliform MF (count/100 mL)	R							-	-	2	4	-	2	0	0/0.1 (mL)
Standard Plate Count MF (count/mL)	R							14	67	800	61	14	18	0	500
Treated Water:															
Present/Absent Test	T														
Total Coliform Background MF (count/100 mL)	T													0	OWDO Bacti
Fecal Coliform MF (count/100 mL)	T													0	OWDO Bacti

NOTE: Information obtained from DWSP results.

BACTERIA (cont'd.)		1985 JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DWSP DETECTION LIMIT	DRINKING WATER OBJ GUIDELINE[1]
Treated Water (cont'd.)															
Standard Plate Count MF (count/100 mL)	T														
If Present/Absent Test Positive:															
Coliform P/A	R														
	T											-			
Fecal Coliform P/A	R														
	T											-			
E. Coli P/A	R														
	T														
Aromonas P/A	R														
	T											-			
Staph. Aureus P/A	R														
	T											-			

NOTE: Information obtained from DWSP results.
* If other than DWSP detection limit

TABLE 4.2 - FOOTNOTES

DWSP samples are collected once a month.

1	= see individual footnotes for agency of guideline origin
c	= California State Department of Health action level
d	= OWDO for DDT (contains other isomers such as OPDDT and PPDDT)
e	= USEPA ambient guideline
ea	= United States Environmental Protection Agency (USEPA) ambient level for endosulfan (contains other isomers)
ep	= USEPA proposed maximum contaminant level for drinking water
g	= suggested Health and Welfare Canada/Ontario Ministry of the Environment guideline value
h	= World Health Organization (WHO) guideline
h*	= World Health Organization (WHO) odour threshold
mg/L	= milligrams per litre, parts per million (ppm)
ng/L	= nanograms per litre, parts per trillion (ppt)
Presence/Absence	= microbiological test to indicate presence or absence of coliform bacteria
R	= raw water
T	= treated drinking water
t	= ODWO interim maximum acceptable concentration (IMAC)
ug/L	= micrograms per litre, parts per billon (ppb)
y	= New York State (taste and odour) proposed drinking water guideline
++	= total trihalomethanes
+++	= combined total: heptachlor and heptachlor epoxide
*	= if other than DWSP detection limit
**	= total of aldrin and dieldrin
***	= chlordane is a mixture of alpha and gamma isomers
!	= Ministry of the Environment and Health and Welfare Canada (IMAC)
-	= No quantifiable results. This includes readings that are non-detectable and readings that are detected but not quantifiable.
G	= ODWO suggested guideline

TABLE 4.3. WATER QUALITY (ONE-YEAR SUMMARY)

GENERAL CHEMISTRY		1984												DWSP DETECTION LIMIT	DRINKING WATER OBJ. GUIDELINE[1]
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		
GENERAL CHEMISTRY															
Alkalinity (mg/L)	R													0.2 (mg/L)	
	T														
Ammonium (Total) (mg/L)	R													0.05 (mg/L)	
	T														
Calcium (mg/L)	R													0.1 (mg/L)	
	T														
Chloride (mg/L)	R													0.2 (mg/L)	250 (mg/L)
	T														
Colour (TCU)	R													0.5 (TCU)	5 (TCU)
	T														
Conductivity (umho/cm)	R													0.01 (umho/cm)	
	T														
Field Chlorine (Combined)	R													0.1 (mg/L)	
	T														
Field Chlorine (Free)	R													0.1 (mg/L)	
	T														
Field Chlorine (Total)	R													0.1 (mg/L)	
	T														
Field pH	R													0.2	
	T														

NOTE: Information obtained from DWSP results.

GENERAL CHEMISTRY (cont'd.)		1984 JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DWSP DETECTION LIMIT	DRINKING WATER OBJ GUIDELINE[1]
Field Temperature (^{o}C)	R T														
Field Turbidity (FTU)	R T														1 (FTU)
Fluoride (mg/L)	R T													0.01 (mg/L)	2.4 (mg/L)
Hardness (mg/L)	R T													0.5 (mg/L)	
Magnesium (mg/L)	R T													0.05 (mg/L)	c
Nitrate (mg/L)	R T													0.05 (mg/L)	10 (mg/L as N)
Nitrite (mg/L)	R T													0.005 (mg/L)	1 (mg/L as N)
Nitrogen Total Kjeldahl (mg/L)	R T													0.1 (mg/L)	0.15 (mg/L) *
pH	R T														
Phosphorus Filtered Reactive (mg/l)	R T													0.01 (mg/L)	

GENERAL CHEMISTRY (cont'd.)		1984 JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DWSP DETECTION LIMIT	DRINKING WATER OBJ. GUIDELINE[1]
Phosphorus (Total) (mg/L)	R													0.01 (mg/L)	
	T														
Sodium (mg/L)	R													0.1 (mg/L)	
	T														
Total Solids (mg/L)	R													1 (mg/L)	
	T														
Turbidity (FTU)	R													0.01 (FTU)	1 (FTU)
	T														
METALS															
Aluminum (mg/L)	R													0.003 (mg/L)	G
	T														
Arsenic (mg/L)	R													0.001 (mg/L)	0.05 (mg/L)
	T														
Barium (mg/L)	R													0.001 (mg/L)	1 (mg/L)
	T														
Beryllium (mg/L)	R													0.001 (mg/L)	
	T														
Boron (mg/L)	R													0.02 (mg/L)	5 (mg/L)
	T														
Cadmium (mg/L)	R													0.0003 (mg/L)	0.005 (mg/L)
	T														

METALS (cont'd.)		1984 JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DWSP DETECTION LIMIT*	DRINKING WATER OBJ. GUIDELINE[1]
Chromium (mg/L)	R T													0.001 (mg/L)	0.05 (mg/L)
Cobalt (mg/L)	R T													0.001 (mg/L)	
Copper (mg/L)	R T													0.001 (mg/L)	1 (mg/L)
Cyanide (mg/L)	R T													0.001 (mg/L)	0.2 (mg/L)
Iron (mg/L)	R T													0.002 (mg/L)	0.03 (mg/L) c
Lead (mg/L)	R T													0.003 (mg/L)	0.05 (mg/L)
Manganese (mg/L)	R T													0.001 (mg/L)	0.05 (mg/L)
Molybdenum (mg/L)	R T													0.001 (mg/L)	
Mercury (ug/L)	R T													0.01 (ug/L)	1 (ug/L)
Nickel (mg/L)	R T													0.002 (mg/L)	

TABLE 4.3 (cont'd.)

METALS (cont'd.)		1984 JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DWSP DETECTION LIMIT	DRINKING WATER OBJ GUIDELINE[1]
Selenium (mg/L)	R T													0.001 (mg/L)	0.01 (mg/L)
Strontium (mg/L)	R T													0.001 (mg/L)	
Tin (no units available)	R T														
Uranium (mg/L)	R T													0.002 (mg/L)	0.02 (mg/L) t
Vanadium (mg/L)	R T													0.001 (mg/L)	
Zinc (mg/L)	R T													0.001 (mg/L)	5 (mg/L) h
PURGEABLES															
Benzene (ug/L)	R T													1 (ug/L)	10 (ug/L) h
Bromoform (ug/L)	R T													1 (ug/L)	350 (ug/L) ++
Carbon Tetrachloride (ug/L)	R T			- -	- -									1 (ug/L)	3 (ug/L) h
Chlorobenzene (ug/L)	R T													1 (ug/L)	100-300 (ng/L) h*

PURGEABLES (cont'd.)		1984 JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DWSP DETECTION LIMIT*	DRINKING WATER OBJ GUIDELINE[1]
Chlorodibromomethane (ug/L)	R			-	-			-	-	-	-	-		1 (ug/L)	350 (ug/L) ++
	T			-	-			4	-	4	6	6			
Chloroform (ug/L)	R			-	-			-	-	48	-	-		1 (ug/L)	350 (ug/L) ++
	T			15	21			18	22	19	31	19			
1,2-Dichlorobenzene (ug/L)	R													1 (ug/L)	400 (ug/L) e
	T														
1,3-Dichlorobenzene (ug/L)	R													1 (ug/L)	400 (ug/L) e
	T														
1,4-Dichlorobenzene (ug/L)	R													1 (ug/L)	400 (ug/L) e
	T														
Dichlorobromomethane (ug/L)	R													1 (ug/L)	350 (ug/L) ++
	T														
1,1-Dichloroethane (ug/L)	R													1 (ug/L)	
	T														
1,2-Dichloroethane (ug/L)	R													1 (ug/L)	10 (ug/L) h
	T														
1,1-Dichloroethylene (ug/L)	R													1 (ug/L)	0.3 (ug/L) h
	T														
T,1,2-Dichloroethylene (ug/L)	R													1 (ug/L)	
	T														

PURGEABLES (cont'd.)		1984 JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DWSP DETECTION LIMIT	DRINKING WATER OBJ. GUIDELINE[1]
Dichloromethane (ug/L)	R T													5 (ug/L)	40 (ug/L) c
1,2-Dichloropropane (ug/L)	R T													1 (ug/L)	
Ethylbenzene (ug/L)	R T													1 (ug/L)	1400 (ug/L) e
Ethylene Dibromide (ug/L)	R T														
M-Xylene (ug/L)	R T													1 (ug/L)	620 (ug/L) c
O-Xylene (ug/L)	R T													1 (ug/L)	620 (ug/L) c
P-Xylene (ug/L)	R T													1 (ug/L)	620 (ug/L) c
Toluene (ug/L)	R T													1 (ug/L)	100 (ug/L) c
1,1,2,2-Tetra-chloroethane (ug/L)	R T													1 (ug/L)	1.7 (ug/L) e
Tetrachloroethane (ug/L)	R T													1 (ug/L)	10 (ug/L) h

PURGEABLES (cont'd.)		1984 JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DWSP DETECTION LIMIT	DRINKING WATER OBJ. GUIDELINE[1]
1,1,1-Trichloroethane (ug/L)	R													1 (ug/L)	1000 (ug/L) c
	T														
1,1,2-Trichloroethane (ug/L)	R													1 (ug/L)	6 (ug/L) e
	T														
Trichloroethylene (ug/L)	R			-	-									1 (ug/L)	30 (ug/L) h
	T			-	-										
Total Trihalomethanes (ug/L)	R								-	52	-	-		3 (ug/L)	350 (ug/L) ++
	T								38	37	56	40			
Trifluorochloro-toluene (ug/L)	R													1 (ug/L)	
	T														
ORGANOCHLORINES															
Aldrin (ng/L)	R													1 (ng/L)	700 (ng/L) **
	T														
Alpha BHC (ng/L)	R													1 (ng/L)	700 (ng/L) c
	T														
Alpha Chlordane (ng/L)	R													2 (ng/L)	700 (ng/L) ***
	T														
Beta BHC (ng/L)	R													1 (ng/L)	300 (ng/L) c
	T														
Dieldrin (ng/L)	R													2 (ng/L)	700 (ng/L) **
	T														

ORGANOCHLORINES (cont'd.)		1984 JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DWSP DETECTION LIMIT	DRINKING WATER OBJ GUIDELINE[1]
Endrin (ng/L)	R T													4 (ng/L)	200 (ng/L)
Gamma Chlordane (ng/L)	R T													2 (ng/L)	700 (ng/L) ***
Heptachlor Epoxide (ng/L)	R T													1 (ng/L)	3000 (ng/L) +++
Heptachlor (ng/L)	R T													1 (ng/L)	3000 (ng/L) +++
Hexachlorobenzene (ng/L)	R T													1 (ng/L)	10 (ng/L) h
Hexachlorobutadiene (ug/l)	R T														
Hexachloroethane (ng/L)	R T													1 (ng/L)	19000 (ng/L) e
Lindane (ng/L)	R T													1 (ng/L)	4000 (ng/L)
Methoxychlor (ng/L)	R T													5 (ng/L)	100000 (ng/L)
Mirex (ng/L)	R T													5 (ng/L)	

ORGANOCHLORINES (cont'd.)		1984 JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DWSP DETECTION LIMIT	DRINKING WATER OBJ. GUIDELINE[1]
Octachlorostyrene (ng/L)	R T													1 (ng/L)	
O,P-DDT (ng/L)	R T													5 (ng/L)	30000 (ng/L) d
Oxychlordane (ng/L)	R T													2 (ng/L)	
PCB Total (ng/L)	R T													20 (ng/L)	3000 (ng/L) t
Pentachlorobenzene (ng/L)	R T													1 (ng/L)	74000 (ng/L) e
P,P-DDD (ng/L)	R T													5 (ng/L)	d
P,P-DDE (ng/L)	R T													1 (ng/L)	d
P,P-DDT (ng/L)	R T													5 (ng/L)	d
1,2,3,4-Tetra-chlorobenzene (ng/L)	R T													1 (ng/L)	
1,2,3,5-Tetra-chlorobenzene (ng/L)	R T													1 (ng/L)	

TABLE 4.3 (cont'd.)

ORGANOCHLORINES (cont'd.)		1984 JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DWSP DETECTION LIMIT	DRINKING WATER OBJ GUIDELINE[1]
1,2,4,5-Tetra-chlorobenzene (ng/l)	R T													1 (ng/L)	38000 (ng/L) e
Thiodan I (ng/L)	R T													2 (ng/L)	74000 (ng/L) ea
Thiodan II (ng/L)	R T													4 (ng/L)	74000 (ng/L) ea
Thiodan Sulphate (ng/L)	R T													4 (ng/L)	
Toxaphene (no units available)	R T														
1,2,3-Trichlorobenzene (ng/L)	R T													5 (ng/L)	10000 (ng/L) y
1,2,4-Trichlorobenzene (ng/L)	R T													5 (ng/L)	15000 (ng/L) y
1,3,5-Trichlorobenzene (ng/L)	R T													5 (ng/L)	10000 (ng/L) y
2,3,6-Trichlorotoluene (ng/L)	R T													5 (ng/L)	
2,4,5-Trichlorotoluene (ng/L)	R T													5 (ng/L)	10000 (ng/L) g

TRIAZINES		1984 JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DWSP DETECTION LIMIT	DRINKING WATER OBJ. GUIDELINE[1]
TRIAZINES															
2,6,A-Trichlorotoluene (ng/L)	R T													5 (ng/L)	
Alachlor (ng/L)	R T														
Ametrine (ng/L)	R T													50 (ng/L)	
Atratone (ng/L)	R T														
Atrazine (ng/L)	R T													50 (ng/L)	46000 (ng/L) !
Bladex (ng/L)	R T													100 (ng/L)	10000 (ng/L) !
Metolachlor (ng/l)	R T														
Prometone (ng/L)	R T													50 (ng/L)	
Prometryne (ng/l)	R T													50 (ng/l)	1000 (ng/l) !
Propazine (ng/L)	R T													50 (ng/L)	

TRIAZINES (cont'd.)		1984 JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DWSP DETECTION LIMIT	DRINKING WATER OBJ GUIDELINE[1]
Sencor (ng/L)	R T													100 (ng/L)	
Simazine (ng/L)	R T													50 (ng/L)	10000 (ng/L) !
SPECIAL PESTICIDES															
2,4-D (ng/L)	R T													100 (ng/L)	100000 (ng/L)
2,4-D Butyric Acid (ng/L)	R T													200 (ng/L)	18000 (ng/L) !
Dicamba (ng/L)	R T													100 (ng/L)	87000 (ng/L) !
Pentachlorophenol (ng/L)	R T													50 (ng/L)	10000 (ng/L) h
Picloram (ng/L)	R T													100 (ng/L)	
2,4-D Propionic Acid (ng/L)	R T													100 (ng/L)	
Silvex (ng/L)	R T													50 (ng/L)	10000 (ng/L)
2,4,5-T (ng/L)	R T													50 (ng/L)	

SPECIAL PESTICIDES (cont'd.)		1984 JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DWSP DETECTION LIMIT	DRINKING WATER OBJ. GUIDELINE[1]
2,3,4,5-Tetra-chlorophenol (ng/L)	R													50 (ng/L)	
	T														
2,3,5,6-Tetra-chlorophenol (ng/L)	R													50 (ng/L)	
	T														
2,3,4-Trichlorophenol (ng/L)	R													100 (ng/L)	
	T														
2,4,5-Trichlorophenol (ng/L)	R													50 (ng/L)	
	T														
2,4,6-Trichlorophenol (ng/L)	R													50 (ng/L)	10000 (ng/L) h
	T														
ORGANOPHOSPHOROUS PEST'S.															
Diazinon (ng/L)	R													50 (ng/L)	14000 (ng/L)
	T														
Dichlorovos (ng/L)	R														
	T														
Dursban (ng/L)	R														
	T														
Ethion (ng/L)	R														
	T														
Guthion (ng/L)	R														
	T														

ORGANOPHOSPHOROUS PEST'S. (cont'd.)		1984												DWSP DETECTION LIMIT	DRINKING WATER OBJ. GUIDELINE[1]
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		
Malathion (ng/L)	R														
	T														
Methylparathion (ng/L)	R													50 (ng/L)	7000 (ng/L)
	T														
Methyltrithion (ng/L)	R														
	T														
Mevinphos (ng/L)	R														
	T														
Parathion (ng/L)	R													50 (ng/L)	35000 (ng/L)
	T														
Phorbate (ng/L)	R														
	T														
Reldan (ng/L)	R														
	T														
Ronnel (ng/L)	R														
	T														
MASS SPEC.															
Di-N-Butyl Phthalate (ug/L)	R													0.1 (ug/L)	34000 (ug/L) e
	T														

MASS SPEC. (cont'd.)		1984												DWSP DETECTION LIMIT	DRINKING WATER OBJ GUIDELINE[1]
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC		
N-Dichloromethylene-Pentachloroanaline (ug/L)	R													0.1 (ug/L)	
	T														
Diphenyl Ether (ug/L)	R													0.1 (ug/L)	
	T														
Fluoranthene (ug/L)	R													0.1 (ug/L)	
	T														
Hexachloropropene (ug/L)	R													0.1 (ug/L)	
	T														
Methyl Phenanthrene (ug/L)	R													0.1 (ug/L)	
	T														
Naphthalene (ug/L)	R													0.1 (ug/L)	
	T														
Pentachlorobutadiene (ug/L)	R													0.1 (ug/L)	
	T														
Pentachloropropane (ug/L)	R													0.1 (ug/L)	
	T														
Pentachloropropene (ug/L)	R													0.1 (ug/L)	
	T														
Pyrene (ug/L)	R													0.1 (ug/L)	
	T														

MASS SPEC. (cont'd.)		1984 JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DWSP DETECTION LIMIT	DRINKING WATER OBJ. GUIDELINE[1]
Tetrachlorbutane (ug/L)	R T													0.1 (ug/L)	
Tetrachlorobiphenyl (ug/L)	R T													0.1 (ug/L)	
BACTERIA															
Raw Water:															
Total Coliform MF	R														
Total Coliform BKGD	R														
Fecal Coliform MF (count/100 mL)	R													0	0/0.1 (mL)
Standard Plate Count MF (count/mL)	R													0	500
Treated Water:															
Present/Absent Test	T														
Total Coliform Background MF (count/100 mL)	T													0	OWDO Bacti
Fecal Coliform MF (count/100 mL)	T													0	OWDO Bacti

BACTERIA (cont'd.)		1984 JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	DWSP DETECTION LIMIT	DRINKING WATER OBJ. GUIDELINE[1]
Treated Water (cont'd.)															
Standard Plate Count MF (count/100 mL)	T														
If Present/Absent Test Positive:															
Coliform P/A	R														
	T														
Fecal Coliform P/A	R														
	T														
E. Coli P/A	R														
	T														
Aromonas P/A	R														
	T														
Staph. Aureus P/A	R														
	T														

* If other than DWSP detection limit

TABLE 4.3 - FOOTNOTES

DWSP samples are collected once a month.

1	= see individual footnotes for agency of guideline origin
c	= California State Department of Health action level
d	= OWDO for DDT (contains other isomers such as OPDDT and PPDDT)
e	= USEPA ambient guideline
ea	= United States Environmental Protection Agency (USEPA) ambient level for endosulfan (contains other isomers)
ep	= USEPA proposed maximum contaminant level for drinking water
g	= suggested Health and Welfare Canada/Ontario Ministry of the Environment guideline value
h	= World Health Organization (WHO) guideline
h*	= World Health Organization (WHO) odour threshold
mg/L	= milligrams per litre, parts per million (ppm)
ng/L	= nanograms per litre, parts per trillion (ppt)
Presence/Absence	= microbiological test to indicate presence or absence of coliform bacteria
R	= raw water
T	= treated drinking water
t	= ODWO interim maximum acceptable concentration (IMAC)
ug/L	= micrograms per litre, parts per billon (ppb)
y	= New York State (taste and odour) proposed drinking water guideline
++	= total trihalomethanes
+++	= combined total: heptachlor and heptachlor epoxide
*	= if other than DWSP detection limit
**	= total of aldrin and dieldrin
***	= chlordane is a mixture of alpha and gamma isomers
!	= Ministry of the Environment and Health and Welfare Canada (IMAC)
-	= No quantifiable results. This includes readings that are non-detectable and readings that are detected but not quantifiable.
G	= ODWO suggested guideline

TABLE 5.0: ALGAE COUNT

MONTH	COUNT	1983	1984	1985	1986
JAN	Max.	518			
	Min.	232			
	Avg.	351	540	337	
	No. Tests	5	5	5	
FEB	Max.	669			
	Min.	366			
	Avg.	566	752	270	
	No. Tests	4	4	4	
MAR	Max.	300			
	Min.	176			
	Avg.	232	650	337	
	No. Tests	4	4	4	
APR	Max.				
	Min.				
	Avg.	1060	488	781	
	No. Tests	4	5	5	
MAY	Max.				
	Min.				
	Avg.	801	1400	571	
	No. Tests	5	4	4	
JUN	Max.				
	Min.				
	Avg.	670	2180	372	
	No. Tests	4	4	4	

NOTE: All units Areal Standard Units (ASU). Data was provided by the Aquatic Biology Section of the Water Resources Branch, Ministry of the Environment, Rexdale, Ontario.

TABLE 5.0 (cont'd.)

MONTH	COUNT	1983	1984	1985	1986
JUL	Max.				
	Min.				
	Avg.	233	297	339	
	No. Tests	3	5	5	
AUG	Max.				
	Min.				
	Avg.	101	122	56	
	No. Tests	4	4	4	
SEP	Max.				
	Min.				
	Avg.	283	300	171	
	No. Tests	4	4	5	
OCT	Max.				
	Min.				
	Avg.	338	278	570	
	No. Tests	5	5	4	
NOV	Max.				
	Min.				
	Avg.	347	281	300	
	No. Tests	4	4	4	
DEC	Max.				
	Min.				
	Avg.	456	376	471	
	No. Tests	3	3	4	

TABLE 6.0 BACTERIOLOGICAL TESTING (1986)

MONTH	R/T	TOTAL COLIFORM					FECAL COLIFORM					FECAL STREPTOCOCCUS			
		Absent	1-5	6-100	101-5000	>5000	Absent	1-5	6-10	11-500	>500	Absent	1	2-50	>50
JAN	R		28	15	4		9	8	3	3					
	T	132					132								
FEB	R	12	10	18			16	14	6	4					
	T	120					120								
MAR	R	10	10	16	2		16	16	6						
	T	114					114								
APR	R	26	16	2			32	12							
	T	132					132								
MAY	R	26	10				32	4							
	T	108					108								
JUN	R	6	24	10			22	16	2						
	T	120					120								
JUL	R	8	22	14			22	20		1					
	T	132					132								
AUG	R		4	36				24	10	6					
	T	120					120								
SEP	R		12	26	1		8	24	6						
	T	120					120								
OCT	R		8	34			14	22	2	4					
	T	126					126								
NOV	R	2	8	14	12		8	8	6	16					
	T	114					114								
DEC	R		10	20	8		4	18	6	8					
	T	114					114								

NOTE: All results are for 100 mL samples. Tests carried out at Ontario Department of Health lab.

R = Raw; T = Treated

TABLE 6.1: BACTERIOLOGICAL TESTING (1985)

MONTH	R/T	TOTAL COLIFORM					FECAL COLIFORM					FECAL STREPTOCOCCUS			
		Absent	1-5	6-100	101-5000	>5000	Absent	1-5	6-10	11-500	>500	Absent	1	2-50	>50
JAN	R		18	22	2		20	16	4	4					
	T	132					132								
FEB	R		22	8	6		18	10		10					
	T	114					114								
MAR	R		10	22	6		10	12		16					
	T	114					114								
APR	R		26	8			24	10							
	T	102					102								
MAY	R		40				38	2							
	T	120					120								
JUN	R		36	2			36	2							
	T	114					114								
JUL	R		30	14			20	22	2						
	T	132					132								
AUG	R		14	26			4	26	10						
	T	120					120								
SEP	R		26	14			8	28	2	2					
	T	120					120								
OCT	R		20	10			16	10		2					
	T	84					84								
NOV	R		12	24	2		2	20	8	10					
	T	120					120								
DEC	R		14	18			6	20	4	2					
	T	96					96								

NOTE: All results are for 100 mL samples. Tests carried out at Ontario Department of Health lab.

R = Raw; T = Treated

TABLE 6.2: BACTERIOLOGICAL TESTING (1984)

MONTH	R/T	TOTAL COLIFORM					FECAL COLIFORM					FECAL STREPTOCOCCUS			
		Absent	1-5	6-100	101-5000	>5000	Absent	1-5	6-10	11-500	>500	Absent	1	2-50	>50
JAN	R		32	10			34	6		2					
	T	126					126								
FEB	R		28	4			26	6							
	T	96					96								
MAR	R		26	14	4		30	2	2	10					
	T	132					132								
APR	R		36		2		24			2					
	T	114					114								
MAY	R		40	4			38	6							
	T	132					132								
JUN	R		30	8			30	6	1						
	T	114					114								
JUL	R		36	4			24	16							
	T	120					120								
AUG	R		10	26	6		2	20	8	12					
	T	126					126								
SEP	R		18	14			4	20	6						
	T	96					96								
OCT	R	2	18	16			10	24		2					
	T	108					108								
NOV	R		28	14			10	22	2	8					
	T	126					126								
DEC	R		16	12			8	16	2						
	T	84					84								

NOTE: All results are for 100 mL samples. Tests carried out at Ontario Department of Health lab.

R = Raw; T = Treated

TABLE 7.0: ONTARIO DRINKING WATER OBJECTIVE EXCEEDENCES INCLUDING ALUMINUM (TREATED WATER AT PLANT)

DATE	PARAMETER	MEASURED PARAMETER	OBJECTIVE LIMIT
24 June 85	Aluminum	0.12 mg/L	0.1 mg/L
25 June 85	Aluminum	0.12 mg/L	0.1 mg/L
26 June 85	Aluminum	0.12 mg/L	0.1 mg/L
15 Aug. 85	Aluminum	0.11 mg/L	0.1 mg/L
04 Sep. 85	Aluminum	0.11 mg/L	0.1 mg/L
29 Sep. 85	Aluminum	0.14 mg/L	0.1 mg/L
01 Oct. 85	Aluminum	0.13 mg/L	0.1 mg/L
02 Oct. 85	Aluminum	0.13 mg/L	0.1 mg/L
03 Oct. 85	Aluminum	0.14 mg/L	0.1 mg/L
04 Oct. 85	Aluminum	0.16 mg/L	0.1 mg/L
08 Oct. 85	Aluminum	0.11 mg/L	0.1 mg/L
16 Oct. 85	Aluminum	0.11 mg/L	0.1 mg/L
28 Oct. 85	Aluminum	0.11 mg/L	0.1 mg/L
27 July 86	Aluminum	0.12 mg/L	0.1 mg/L
13 Aug. 86	Aluminum	0.14 mg/L	0.1 mg/L
14 Sep. 86	Aluminum	0.14 mg/L	0.1 mg/L
24 Oct. 86	Aluminum	0.11 mg/L	0.1 mg/L

NOTE: Aluminum residual measured by colourimetric method in the plant laboratory. This method is "a means for estimating aluminum with simpler instrumentation" (Standard Methods, 1985, p. 182) and is not as accurate as atomic absorption methods.

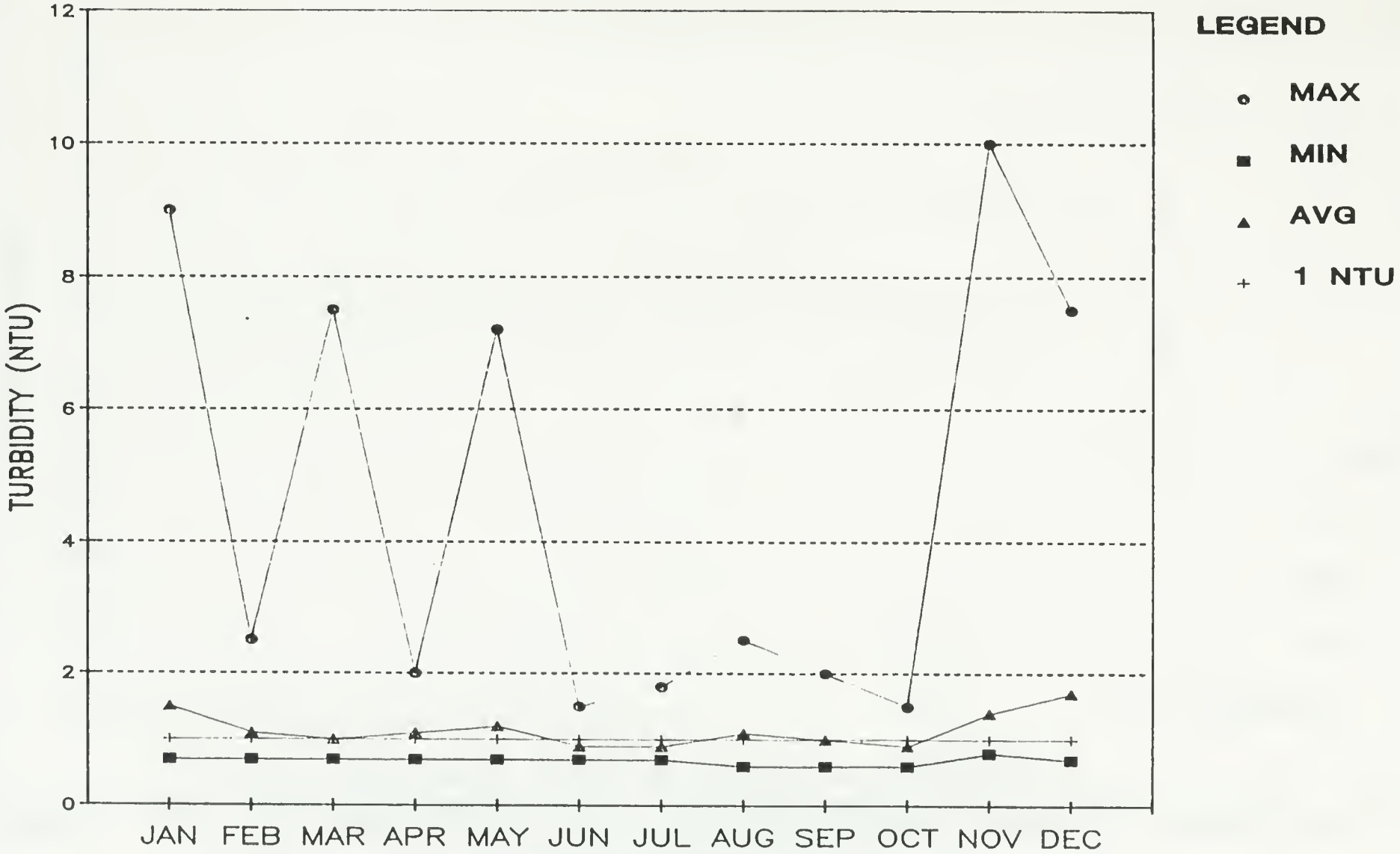
APPENDIX B

GRAPHICAL TURBIDITY DATA

KINGSTON WTP

FIG. 1: COMPOSITE PROFILE

RAW WATER TURBIDITY RANGES

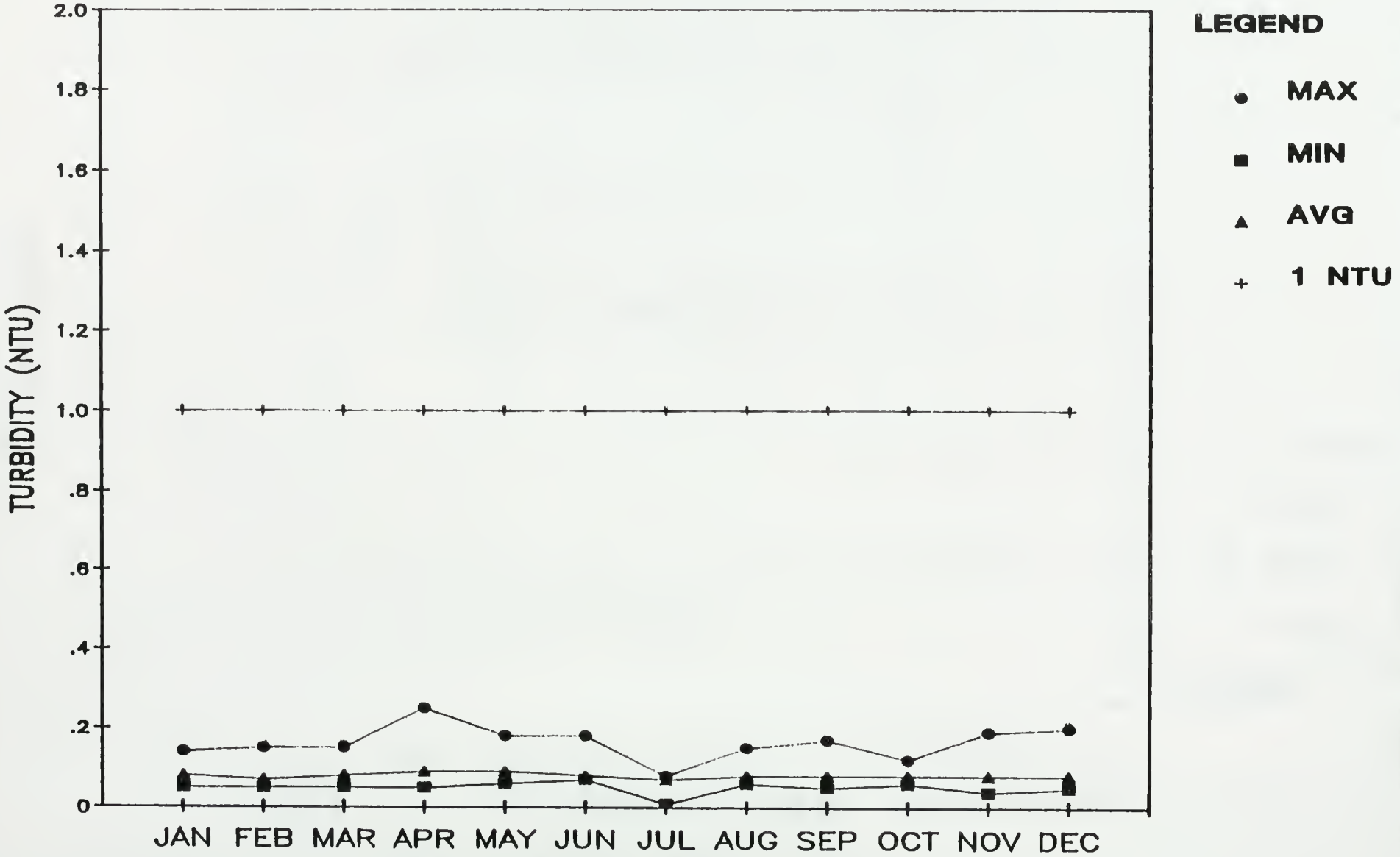


FOR PERIOD 1984–1986

KINGSTON WTP

FIG. 2: COMPOSITE PERFORMANCE PROFILE

TREATED WATER TURBIDITY RANGES



FOR PERIOD 1984–1986

APPENDIX C
JAR TESTING

KINGSTON WTP

Jar Test Procedure

The jar test procedure that was used for Test Nos. 1 and 2 was as follows:

1. Two hundred mL sample used.

2. Two minutes fast mix, i.e. 200 rpm.

3. Thirty minutes flocculation, i.e. 140 rpm.

4. Thirty minutes settling time.

5. Filtration through a Whatman glass microfibre filter, followed by 1.2 µm filter.

The procedure for Test No's. 3 and 4 was as follows:

1. One litre samples used.

2. Two minutes flash mix (<100 rpm).

3. Thirty minutes flocculation (30 rpm).

4. Thirty minutes settling time.

5. Filtration through a 1.2 µm membrane filter by vacuum filtration.

LABORATORY RESULTS SHEET

DATE	PROJECT DESCRIPTION	JOB NO.
8 Apr/87	MOE Water Plant Optimization Study - Kingston WTP	380.72

SAMPLE NO. & DESCRIPTION

No. 1 - Typical raw water sample collected 2 April 1987

PARAMETERS	SAMPLE NO. 1	SAMPLE NO.	SAMPLE NO.	SAMPLE NO.
pH	8.36			
Colour (HCU)	5			
Turbidity (NTU)	1.1			
Alkalinity (mg/L as $CaCO_3$)	116			
Hardness (mg/L as $CaCO_3$)	152			
Iron (mg/L)				
Manganese (mg/L)				

COMMENTS

CONDUCTED BY	REVIEWED BY

Gore & Storrie Limited TEST NO. 1

WATER TREATABILITY RESULTS SHEET

DATE	PROJECT DESCRIPTION	JOB NO.
8 Apr/87	MOE - Water Plant Optimization Study Kingston WTP	380.72

TEST DESCRIPTION

Removal of Turbidity and Colour with Alum

JAR NO.	CHEMICAL DOSAGES (mg/L)		FLOC RATING	WATER QUALITY AFTER TREATMENT					
	Alum			pH	Turb. (NTU)	Colour (HCU)	Alk. (mg/L)	Hard. (mg/L)	
1									
2	5		4	8.33	0.18	<5	110	152	
3	10		4	8.30	0.17	<5	110	152	
4	15		3	8.20	0.17	<5	108	152	
5	20		2	8.20	0.15	<5	100	152	
6	25		2	8.12	0.16	<5	98	152	
7	30		3	8.05	0.11	<5	98	152	
RAW, UNTREATED				8.36	1.1	5	116	152	

SAMPLE TEMPERATURE Start: 9°C Finish: 17.0°C

COMMENTS

Floc Rating:
1 - very good
2 - good
3 - poor
4 - very poor
5 - no floc

CONDUCTED BY REVIEWED BY

Gore & Storrie Limited TEST NO. 2

WATER TREATABILITY RESULTS SHEET

DATE	PROJECT DESCRIPTION	JOB NO.
10 Apr/87	MOE Water Plant Optimization Study Kingston WTP	380.72

TEST DESCRIPTION

Removal of Turbidity and Colour with Polyaluminum Chloride

JAR NO.	CHEMICAL DOSAGES (mg/L)		FLOC RATING	WATER QUALITY AFTER TREATMENT					
	(1) PACl			pH	Turb. (NTU)	Colour (HCU)	Alk. (mg/L)	Hard. (mg/L)	
1									
2	3		4	8.24	0.16	<5	112	152	
3	5		4	8.18	0.17	<5	112	152	
4	7.5		3	8.20	0.18	<5	112	154	
5	10		4	8.15	0.21	<5	112	154	
6	12.5		3	8.14	0.22	<5	110	153	
7	15		4	8.13	0.25	<5	112	153	
RAW, UNTREATED				8.36	1.1	5	116	152	

SAMPLE TEMPERATURE Start: 9.0°C Finish: 17.5°C

COMMENTS

Floc Rating:
1 - very good
2 - good
3 - poor
4 - very poor
5 - no floc

(1) Sternson polyaluminum chloride added from a 10 mg/mL solution.

CONDUCTED BY REVIEWED BY

Gore & Storrie Limited TEST NO. 3

WATER TREATABILITY RESULTS SHEET

DATE	PROJECT DESCRIPTION	JOB NO.
14 Sep. 87	MOE Water Plant Optimization Study Kingston WTP	380.72

TEST DESCRIPTION

Removal of Turbidity and Colour with Alum or Polyaluminum Chloride
Aluminum Residuals Tested - 1 Litre Jar Tests, Raw Water #1

JAR NO.	CHEMICAL DOSAGES (mg/L)		FLOC RATING	(1) WATER QUALITY AFTER TREATMENT					
	(2) Alum	(3) PACl		pH	Turb. (NTU)	Colour (HCU)	Alk. (mg/L)	Hard. (mg/L)	Al. (mg/L)
raw									
2	5		4	7.92	0.20	<5	112	158	0.27
3	10		3	7.90	0.14	<5	110	158	0.24
4	20		2	7.89	0.15	<5	106	156	0.20
5		3	4	8.01	0.16	<5	113	158	0.15
6		5	4	8.03	0.17	<5	114	156	0.20
7		7.5	4	8.05	0.16	<5	114	158	0.24
RAW,UNTREATED				7.95	0.95	<5	112	158	

SAMPLE TEMPERATURE Start: 24.0°C Finish: 24.0°C

COMMENTS

(1) Treatment Steps: Alum or polyaluminum chloride added; stirred at greater than 100 rpm for 2 minutes, 30 rpm for 30 minutes; settled for 30 minutes and filtered thorugh a 1.2 µm membrane filter by vacuum filtration.

(2) Commercial grade equivalent $Al_2(SO_4)_3 \cdot 14H_2O$ added from a 10 mg/mL solution.

(3) Sternson polyaluminum chloride added from a 10 mg/mL solution.

Floc Rating:
1 - very good
2 - good
3 - poor
4 - very poor
5 - no floc

CONDUCTED BY	REVIEWED BY

Gore & Storrie Limited TEST NO. 4

WATER TREATABILITY RESULTS SHEET

DATE	PROJECT DESCRIPTION	JOB NO.
20 Sep. 87	MOE Water Plant Optimization Study Kingston WTP	380.72

TEST DESCRIPTION

Removal of Turbidity and Colour with Alum

Aluminum Residuals Tested - 1 Litre Jar Tests, Raw Water #1.

JAR NO.	CHEMICAL DOSAGES (mg/L)		FLOC RATING	(1) WATER QUALITY AFTER TREATMENT					
	(2) Alum			pH	Turb. (NTU)	Colour (HCU)	Alk. (mg/L)	Hard. (mg/L)	Al. (mg/L)
raw									
2	20		3	7.64	0.14	<5	105	157	0.22
3	25		2-3	7.60	0.12	<5	100	158	0.18
4	30		2	7.60	0.11	<5	97	156	0.18
5	35		2	7.59	0.16	<5	96	157	0.15
6	40		2	7.54	0.14	<5	95	157	0.17
7									
RAW, UNTREATED				7.87	1.1	5	116	152	

SAMPLE TEMPERATURE Start: 23.0°C Finish: 23.0°C

COMMENTS

(1) Treatment Steps: Alum or polyaluminum chloride added; stirred at greater than 100 rpm for 2 minutes, 30 rpm for 30 minutes; settled for 30 minutes and filtered thorugh a 1.2 µm membrane filter by vacuum filtration.

(2) Commercial grade equivalent $Al_2(SO_4)_3 \cdot 14H_2O$ added from a 10 mg/mL solution.

Floc Rating:
1 - very good
2 - good
3 - poor
4 - very poor
5 - no floc

CONDUCTED BY	REVIEWED BY

APPENDIX D
DAILY RECORD

DATE _____

WATER PURIFICATION PLANT - DAILY REPORT

1.	Total raw water pumped	m^3
2.	Water dumped from the settling tanks	m^3
3.	Total water to the filters	m^3
4.	Filter wash water	m^3
5.	Surface wash water	m^3
6.	Settling chamber wash water	m^3
7.	Plant service water	m^3
8.	Lawn service water	m^3
9.	Total plant service and wash water	m^3
10.	Plant output to the city	m^3
11.	Filling Third Avenue Reservoir (-)	m^3
12.	Pumping from Third Avenue Reservoir (+)	m^3
13.	Net to distribution system	m^3
14.	Net to distribution system last year	m^3
15.	King Street clear well - midnight	m
16.	Third Avenue Reservoir - midnight	m
17.	Water temperature	^{0}C
18.	Pittsburgh Township	m^3
19.	City residual - free	mg/L
20.	City residual - combined	mg/L

WATER PURIFICATION PLANT SUPERINTENDENT

WATER PURIFICATION PLANT DAILY REPORT

DATE: _____

IME	RAW m^3	CITY m^3	PRES-SURE	EE. TANK	CLEAR WELL	CHLO mg/1	SO_2 mg/1	RESID. mg/1	AIR TEMP.	HL 1	HL 2	HL 3	HL 4	HL D1	HL D2	LL 1	LL 2	LL 3	LL 4	LL D1	LL D2	R 1	R 2	RES VAL
1																								
2																								
3																								
4																								
5																								
6																								
7																								
8																								
9																								
0																								
1																								
12																								
3																								
4																								
15																								
6																								
7																								
18																								
9																								
0																								
21																								
2																								
3																								
24																								

METER READING m^3

METER	FROM	TO	QUANTITY
RAW NORTH			
RAW SOUTH			
TOTAL RAW PUMPS			
CITY EAST HEADER			
CITY WEST HEADER			
TOTAL CITY PUMPS			
RES. - +			
NET TO CITY			
FILLING RES. 1			
FILLING RES. 2			
FILLING RES. 3			
TOTAL FILLING -			
PUMPING RES. 1			
PUMPING RES. 2			
PUMPING RES. 3			
TOTAL OUT OF RES. +			
BARRIEFIELD			
WASH WATER			
TOTALIZER CITY			
TOTALIZER RAW			
ELECTRIC PEAK			
ELECTRIC KW HRS.			
ALUM			

AIR TEMPERATURE
AIR TEMPERATURE HIGH
AIR TEMPERATURE LOW
0 WASHINGS
FILTER RUNS
PEAK PLANT
LAK CITY
#1 H.L. PUMP A.C. D.C.
#2 H.L. PUMP A.C. D.C.
#3 H.L. PUMP A.C. D.C.
#4 H.L. PUMP A.C. D.C.

REMARKS

SHIFT

FROM	TO	OPERATOR

TERMS OF REFERENCE

Purpose

To review the present conditions and determine an optimum treatment strategy for contaminant removal at the plant, with emphasis on particulate materials and disinfection processes.

Work Tasks

1. Receive an information package from the MOE. Review the information provided and meet with the MOE staff, if required, to discuss the project.

2. Document the quality and quantity of raw and treated waters.

3. Define the present treatment processes and operating procedures. Prepare a progress report on Works Tasks 1-3 for the Project Committee.

4. Assess the methods of efficient particulate removal which would utilize the present major capital works of the plant. Evaluate the particulate removal efficiency and sensitivity of operation, assuming optimum performance of the plant.

5. Assess current disinfection practices and possible improvement methods.

6. Describe possible short and long-term process modifications to obtain optimum disinfection and contaminant removal.

7. Prepare a draft report for the project committee's review.

8. Prepare the final report.

1. RECEIVE AN INFORMATION PACKAGE FROM THE MOE. REVIEW THE INFORMATION PROVIDED AND MEET WITH THE MOE STAFF, IF REQUIRED, TO DISCUSS THE PROJECT.

Elements of Work

(a) Receive an information package from the MOE concerning the plant and the study. This package includes a general terms of reference, a general table of contents for organizing the study in a manner consistent with other plant reports, the WPOS reporting tables and a copy of Ontario Drinking Water Objectives.

(b) Review the information and prepare for a meeting to initiate the work on the project, including preparation of a schedule of manpower and staff committments.

(c) Meet with the MOE to discuss the available data, the terms of reference, and the project staff and work schedule. If a consultant is carrying out more that one study it may not be necessary to meet with the MOE at the start of each study.

2. DOCUMENT THE QUALITY AND QUANTITY OF RAW AND TREATED WATERS.

Elements of Work

(a) Prepare a monthly summary of maximum, minimum, and average flows for the last three consecutive years (Table 1.0). Address any discrepancies which exist between raw and treated flow rates.

(b) Based on the above, briefly review and tabulate for the last three years, the monthly maximum, minimum, and average per capita flow for the total population served by the plant (Table 1.1). Compare the plant data with typical per capita flows for the local region. Indicate major consumers who may influence the figures.

(c) Document the methods of measuring the raw and treated water flow rates.

(d) Summarize, for the last three consecutive years, where available, the raw and treated water; turbidity, colour, residual aluminum/iron, pH, temperature and treatment chemical dosages (other than disinfection and fluoridation). The summary should indicate the monthly daily average and maximum and minimum day (Table 2.0).

For the same three year period, tabulate also the daily average for the typical seasonal months of January, April, July and October as well as other months in which problems with particulate removal occurred (Tables 2). Document enough data to define and evaluate those problems.

Record other data, such as particulate counting, suspended solids, and algae counting (Table 5.0) which could reflect on particulate removal efficiency.

Document the source and methods used in determining all information.

A comparison should be made between the plant and outside laboratory information to ascertain the relative validity of the data. For plant data, emphasis should be given to plant laboratory tests rather than continuous process control instruments.

(e) Summarize for the last three consecutive years, where available, the disinfectant demand, dosages (including all disinfection related chemicals and residuals) for all application points as well as fluoridation dosage and residual. The summary should indicate the monthly daily average and maximum and minimum day (Table 3.0).

For the same three year period, tabulate (Table 3) the daily average for the typical seasonal months of January, April, July and October as well as other months in which problems with chlorine residuals and/or positive bacterial tests identified in Table 6. Document enough data to define and evaluate those problems.

Document the methods of dosage evaluation and residual measurements, and establish the validity of the data provided.

(f) Prepare a summary, based on at least three years of data, of the raw and treated water quality testing data for physical, microbiological, radiological, and chemical water quality information (Table 4). Document as much data as is needed to show possible seasonal trends in water quality. Where possible, show corresponding sets of raw and treated water quality information.

Document the source and methods used in determining all water quality information and establish the validity of the data, comparing plant and outside laboratory data.

(g) Tabulate, for the last three consecutive years, the raw and treated water bacterial test information at the plant (Table 6).

Document the source and methods used for all data provided.

(h) Document the water sampling systems (source, pump, line-material and size, vertical rise velocity sampling location) used in the plant (similar to DWSP Questionnaire in Appendix A).

(i) Prepare a summary of inplant testing including Test, Sampling Point, Testing Frequency, Reporting Frequency, Testing Instrumentation including calibration.

(j) Identify other water quality concerns, not related to particulate removal or disinfection, which should be considered as part of the assessment phase of this evaluation program.

3. DEFINE THE PRESENT TREATMENT PROCESSES AND OPERATING PROCEDURES. PREPARE A PROGRESS REPORT ON WORK TASKS 1-3 (8 COPIES), FOR THE PROJECT COMMITTEE.

Elements of Work

(a) Where drawings are available, assemble sufficient record drawings of a reduced size, to document the general site layout and the interrelationship of major plant components. If available, include a process and piping diagram (PAPD) of the plant operations.

(b) Prepare a simplified block schematic of all major plant components including chemical systems and indicating design parameters. Appendix B is an example of the required standard schematic.

(c) Prepare a photographic record of the plant facilities, illustrating all of the major plant components and chemical feed systems. The record should include approximately 30-40 coloured (9 cm x 12 cm) (or 10 cm x 15 cm) prints, suitably labelled. The progress and draft reports may include photocopies in lieu of the prints.

(d) Tabulate the design parameters for all the major plant components, with emphasis on the process operations, including chemical feeds. This information, as a minimum, must be consistent with the DWSP Questionnaire (Appendix A) and must be confirmed and verified by field observations. The design parameters should be evaluated at design, rated and actual operational flows.

(e) Prepare a summary of how the plant is operated, including chemical dosage control, such as jar testing information, filter backwashing procedures and initiation, and pumping and flow control.

(f) Document all reported and other apparent problems in plant operations and/or in the distribution system related to water quality. In addition list the health related parameters which exceed the Ontario Drinking Water Objectives (Table 7).

(g) Submit 8 copies of the progress report to the Prime Consultant for distribution to the Project Committee.

4. ASSESS THE METHODS OF EFFICIENT PARTICULATE REMOVAL WHICH WOULD UTILIZE THE PRESENT MAJOR CAPITAL WORKS OF THE PLANT. EVALUATE THE PARTICULATE REMOVAL EFFICIENCY AND SENSITIVITY OF OPERATION, ASSUMING OPTIMUM PERFORMANCE OF THE PLANT.

Elements of Work

(a) Assess the validity and implication of all information relating to particulate removal provided in Work Tasks 1 and 2 with emphasis on method, metering and sampling, etc.

(b) Using information provided in Work Tasks 1, 2 and 3 evaluate the plant's particulate removal efficiency. The basis of minimum particulate removal should be 1.0 F.t.u. It should, however, be recognized that it is desirable to strive for an operational level which is as low as is achievable.

(c) Conduct an evaluation of possible optimum performance alternatives. Include jar testing using established industry practice.

(d) Evaluate the feasibility of optimum removal using the existing plant capital works. This evaluation should consider the worst case water quality conditions, even though field testing data may not be available during the initial phase of the study (see Work Task 7).

(e) Describe the operational procedures, management strategies, and equipment required for various feasible alternatives. Estimate chemical dosages, level of operational expertise, and sensitivity of operation of the alternatives.

5. ASSESS CURRENT DISINFECTION PRACTICES AND POSSIBLE IMPROVEMENT METHODS.

Elements of Work

(a) Assess the validity and implication of all information relating to disinfection provided in Work Tasks 1, 2 and 3 with emphasis on method, metering and sampling etc.

(b) Using the information provided in Work Tasks 1, 2 and 3 evaluate the plant's ability to disinfect the water. The basis of minimum disinfection should be to ensure a water quality as described in the Ontario Drinking Water Objectives.

(c) Conduct an evaluation of possible optimum disinfection procedures for the plant, with consideration also given to the reduction of chlorinated by-products in the treated water.

(d) Evaluate the feasibility of the various alternatives using the existing plant capital works.

(e) Assess the relative merits of the alternatives. Describe the operational procedures, management strategies, and equipment required for the feasible alternatives. Estimate chemical dosages, level of operational expertise, and sensitivity of operation for the alternatives.

6. DESCRIBE POSSIE HORT AND LONG-TERM PROCESS MODIFICATIONS TO OBTAIN OPTIMUM I NFECTION AND CONTAMINANT REMOVAL.

Elements of Work

(a) Prepare a list of modifications which should be considered for detailed implementation evaluation. Provide an estimated cost and possible schedule for implementation for each of the proposed modifications.

It is not the purpose of this study to provide a detailed implementation scheme for plant rehabilitation. It is, however, necessary to scope the feasible short and long-term process modifications required to achieve optimum disinfection and contaminant removals.

(b) Incorporate (a) above in the draft report.

7. PREPARE A DRAFT REPORT FOR THE PROJECT COMMITTEE'S REVIEW. (8 COPIES).

Elements of Work

(a) The report must include all information for Work Tasks 1-6.

The information must be organized and presented in a logical and co-ordinated fashion. A general table of contents (Appendix C) is provided for organizing the material in a manner consistent with other plant reports.

Submit the draft report for review by the Project Committee.

(b) Meet with the Project Committee on site at least one week after submission of the report.

(c) Prepare a separate letter report containing recommendation(s) concerning the need for additional field testing to cover quality conditions not available during the period of this study. The Project Committee may decide to delay completion of the final report until field data can be obtained to confirm the predictions of performance for the worst case water conditions.

8. PREPARE THE FINAL REPORT.

Elements of Work

(a) Conduct additional field testing if required. Discuss the implementations of the results with the Project Committee if the results differ from the predicted performance.

(b) Amend the report as per review comments, incorporating additional field data if required.

(c) Submit 25 copies of the final reports (including the colour photographs) to the MOE for distribution.